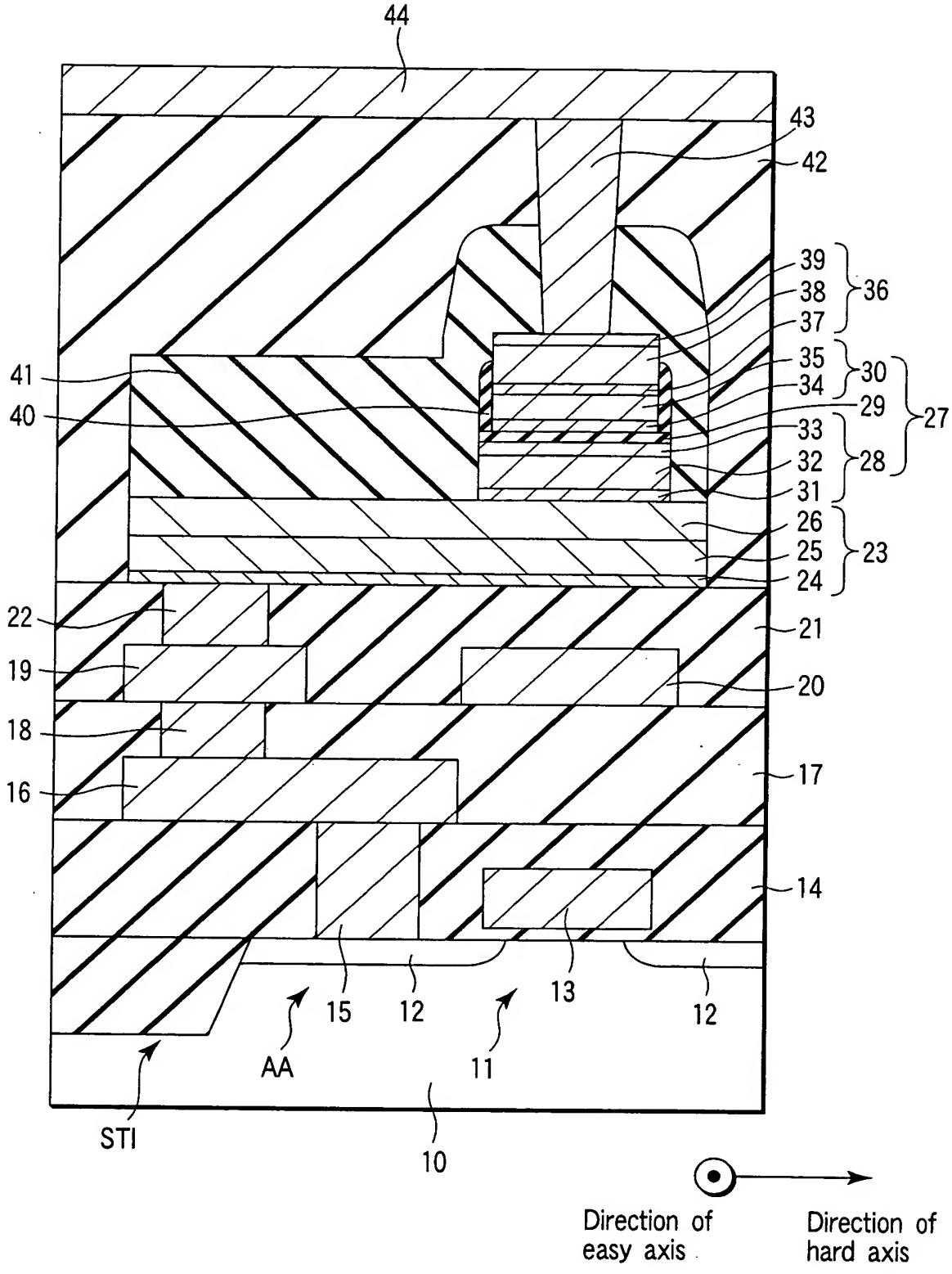
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AA
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STI
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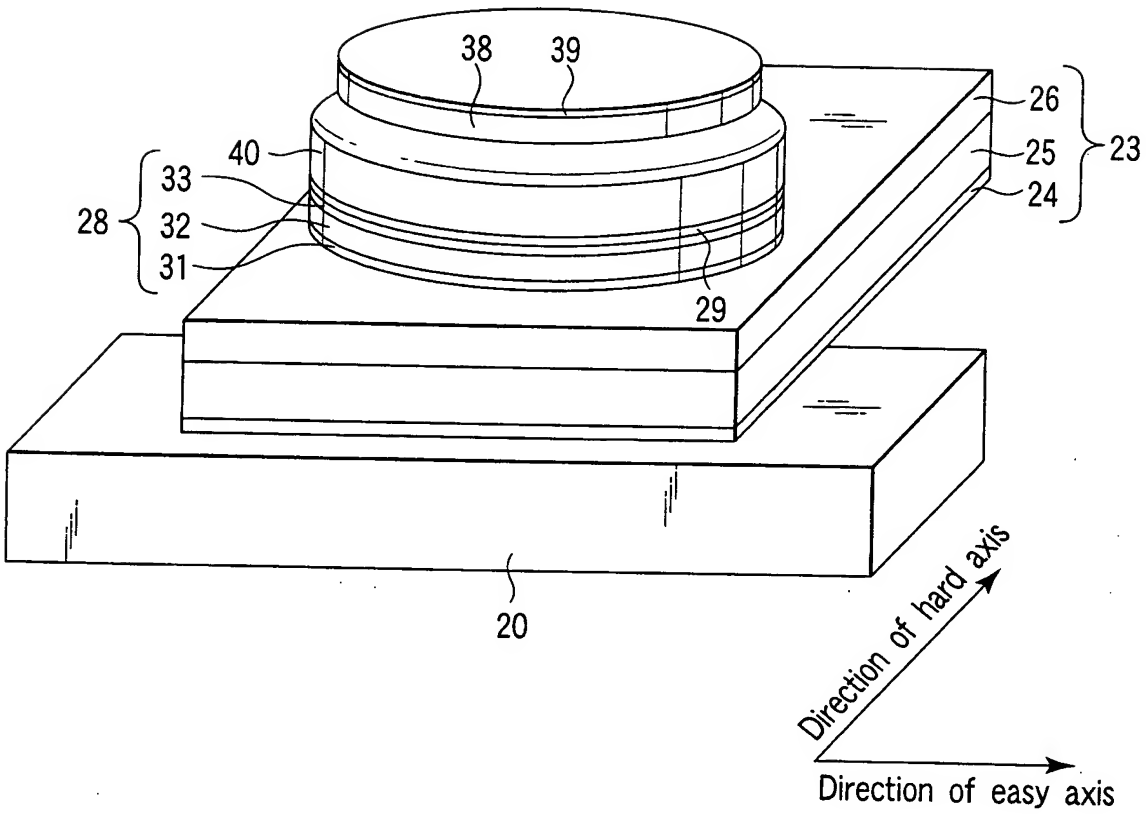
Direction of easy axis
Direction of hard axis

FIG. 1A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Direction of hard axis
Direction of easy axis

FIG. 1B

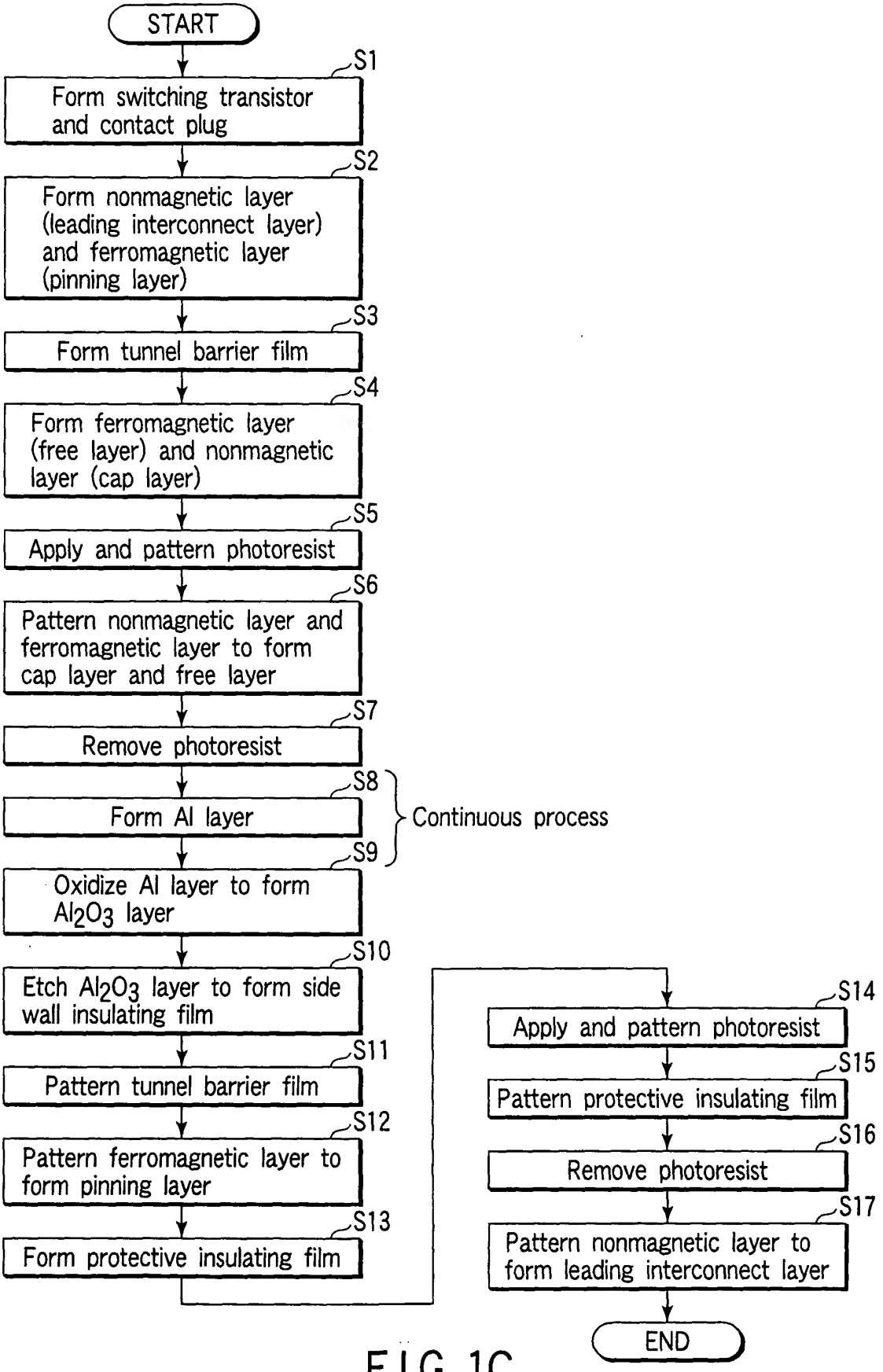
START
S1
Form switching transistor and contact plug
S2
Form nonmagnetic layer (leading interconnect layer) and ferromagnetic layer (pinning layer)
S3
Form tunnel barrier film
S4
Form ferromagnetic layer (free layer) and nonmagnetic layer (cap layer)
S5
Apply and pattern photoresist
S6
Pattern nonmagnetic layer and ferromagnetic layer to form cap layer and free layer
S7
Remove photoresist
S8
Form Al layer
S9
Oxidize Al layer to form Al_2O_3 layer
Continuous process
S10
Etch Al_2O_3 layer to form side wall insulating film
S11
Pattern tunnel barrier film
S12
Pattern ferromagnetic layer to form pinning layer
S13
Form protective insulating film
S14
Apply and pattern photoresist
S15
Pattern protective insulating film
S16
Remove photoresist
S17
Pattern nonmagnetic layer to form leading interconnect layer
END

FIG. 1C

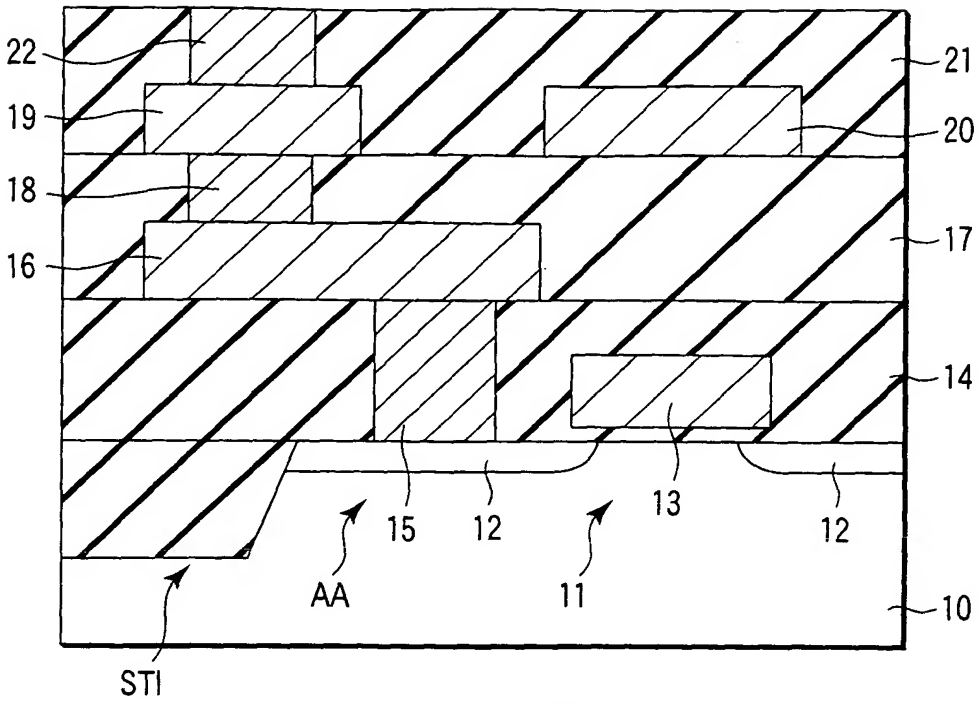

FIG. 2A

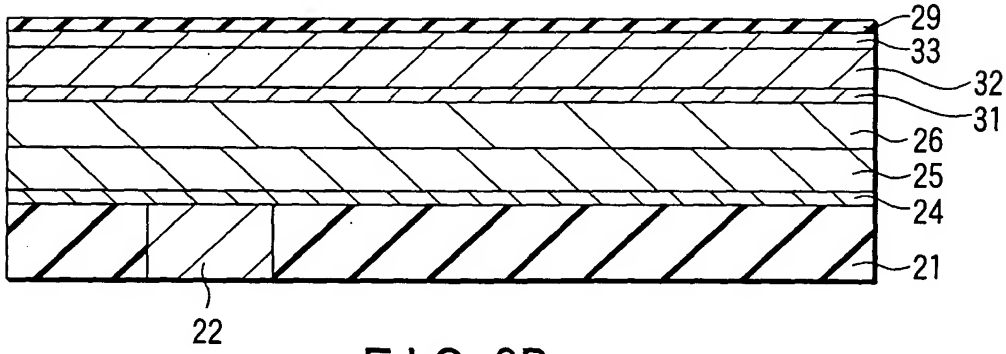

FIG. 2B

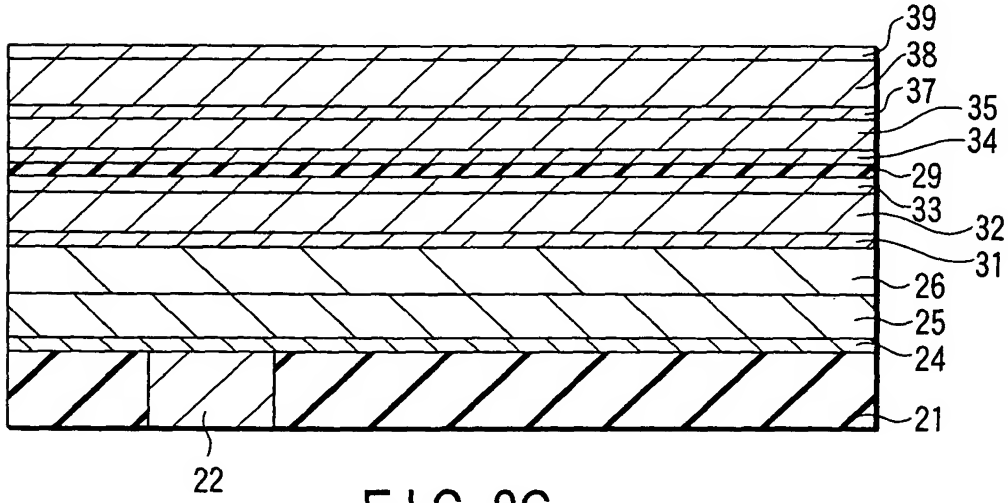

FIG. 2C

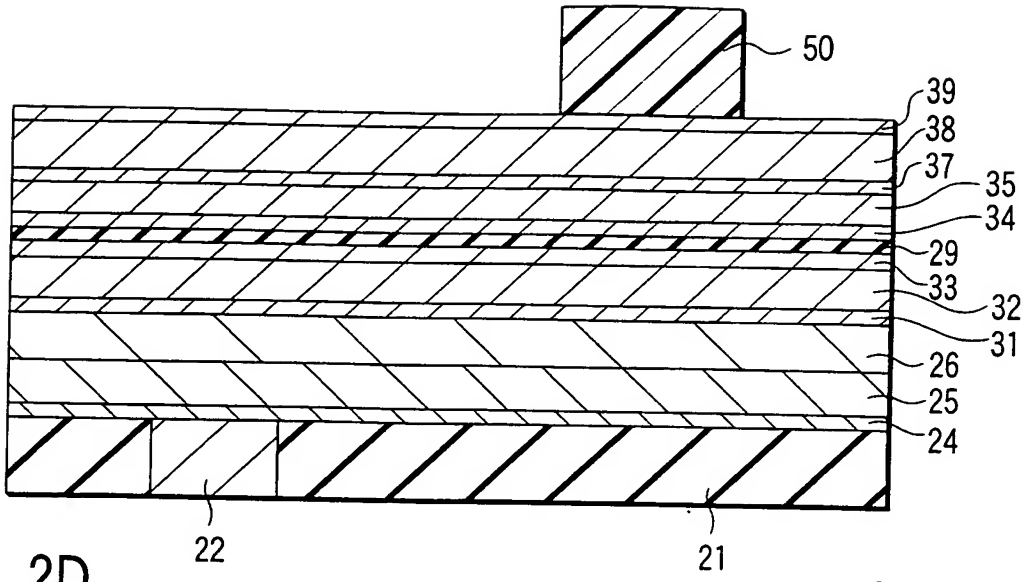

FIG. 2D

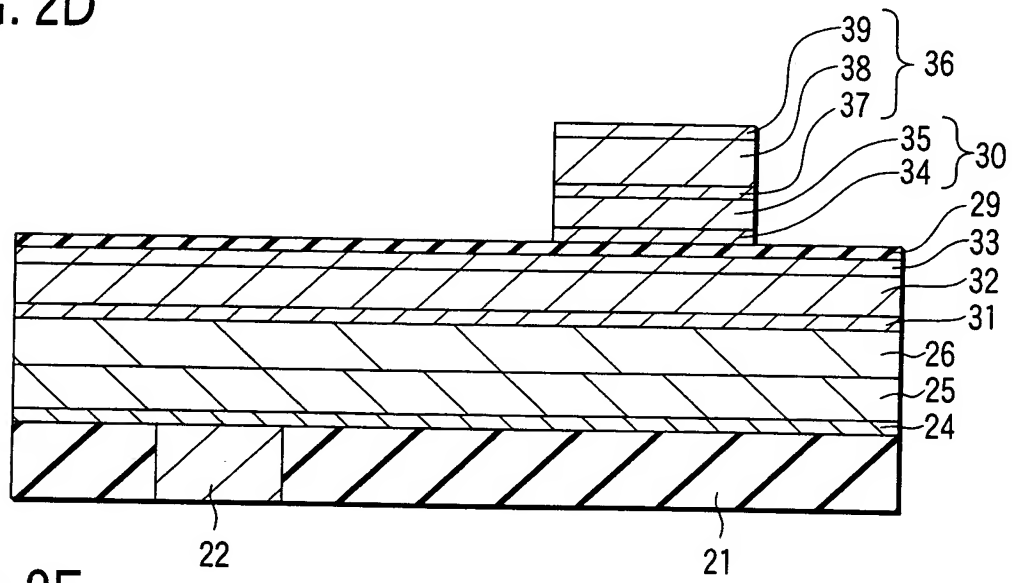

FIG. 2E

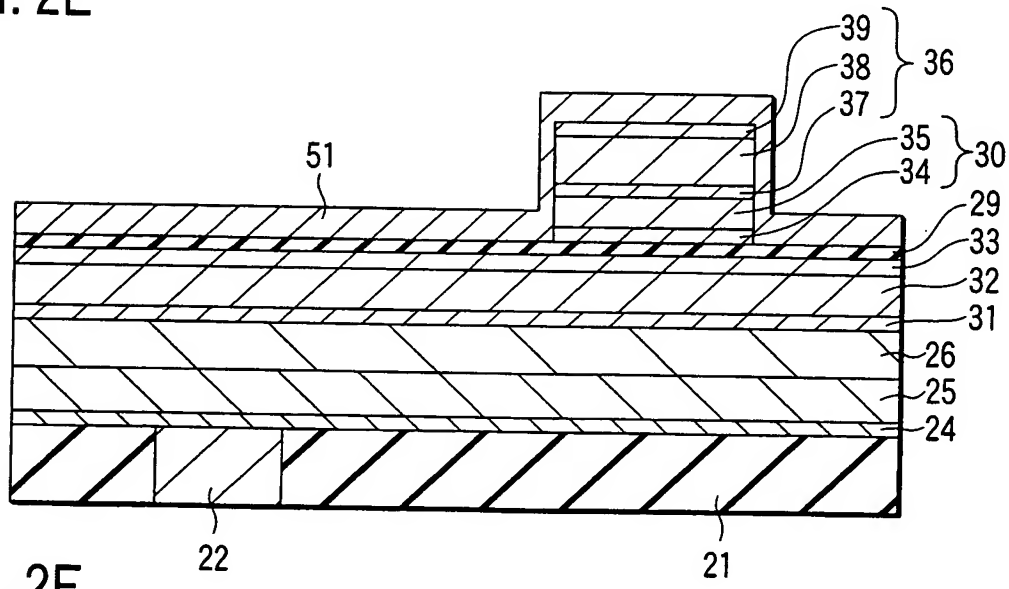

FIG. 2F

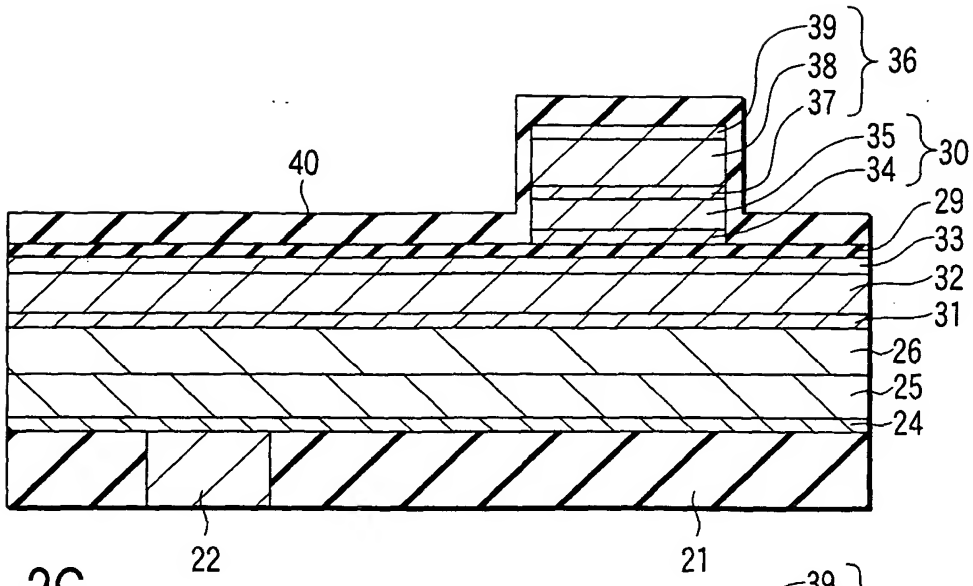

FIG. 2G

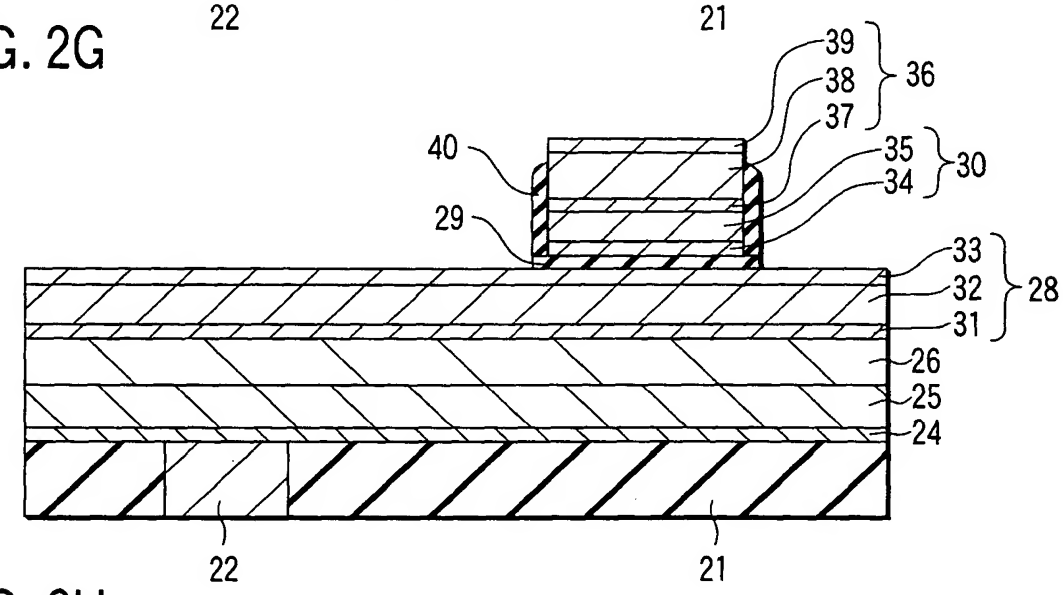

FIG. 2H

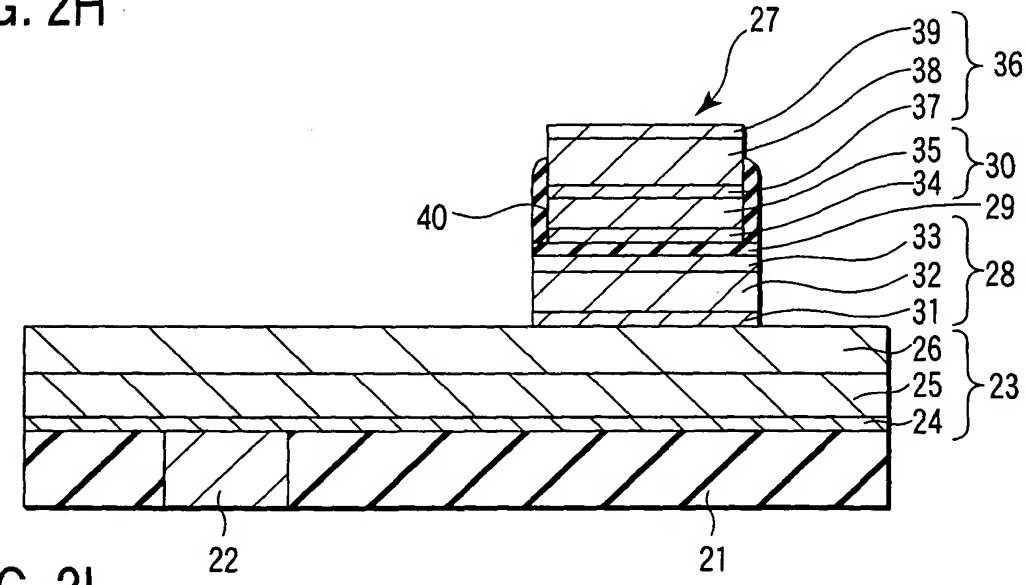

FIG. 2I

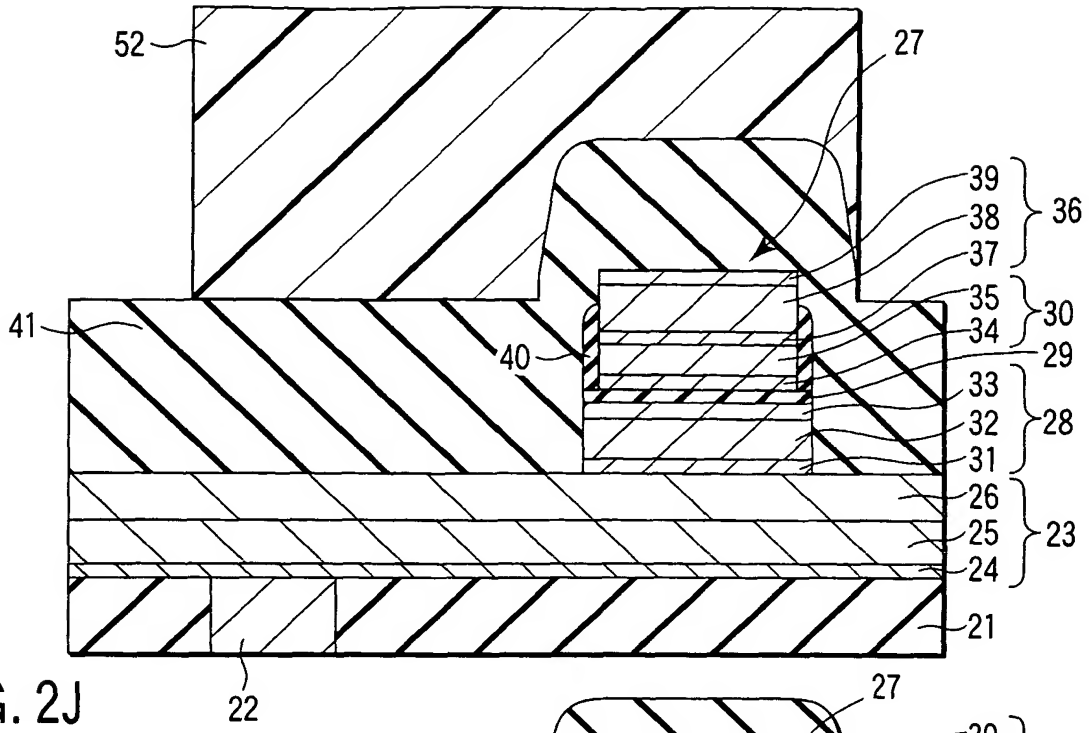

FIG. 2J

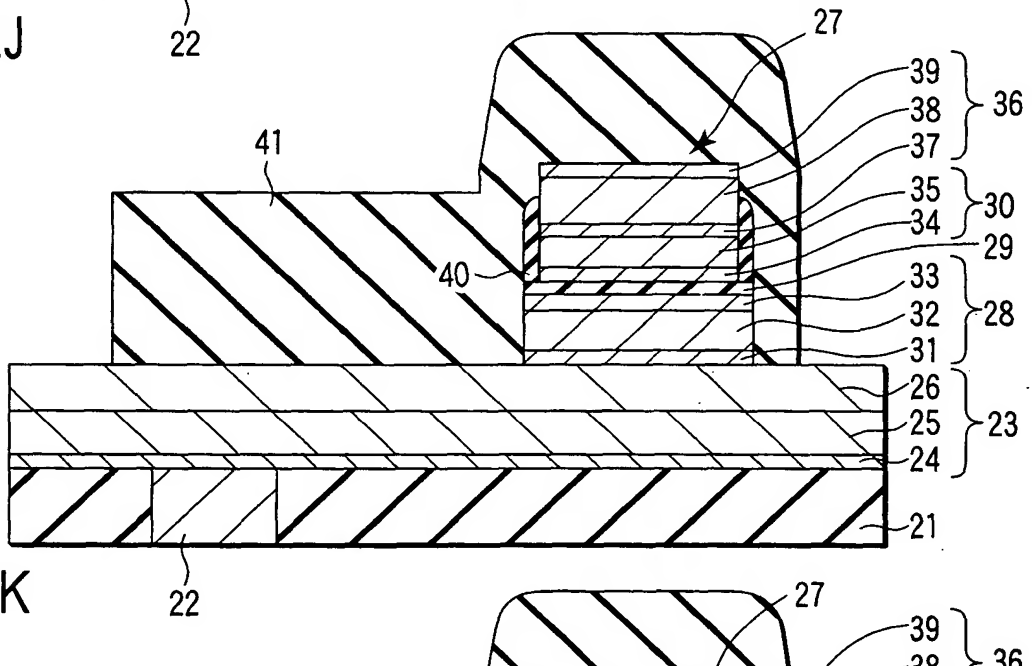

FIG. 2K

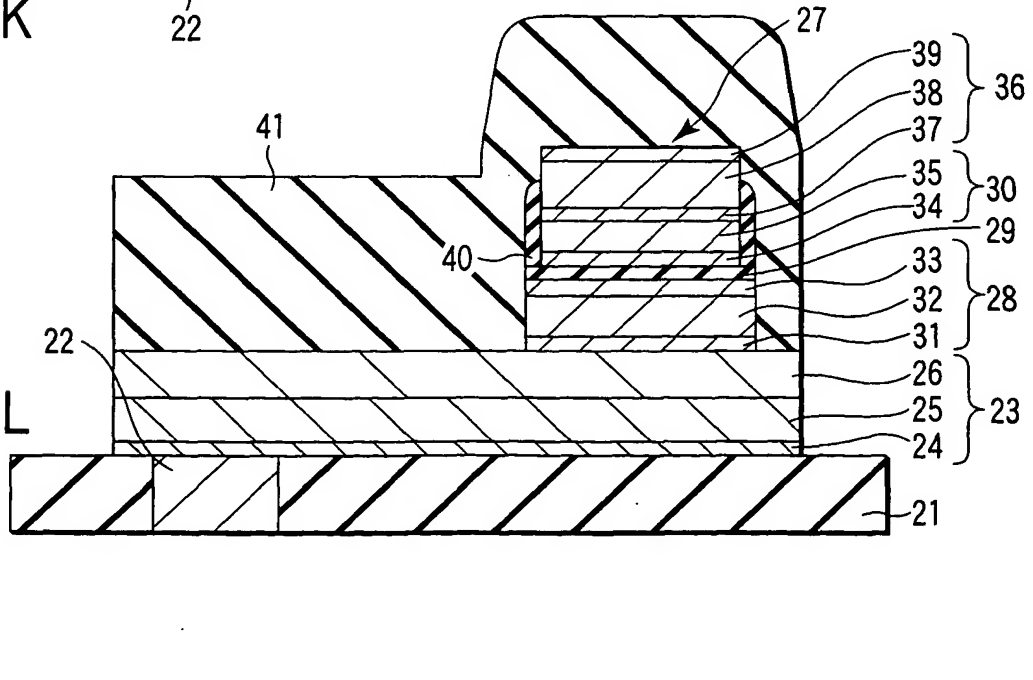

FIG. 2L

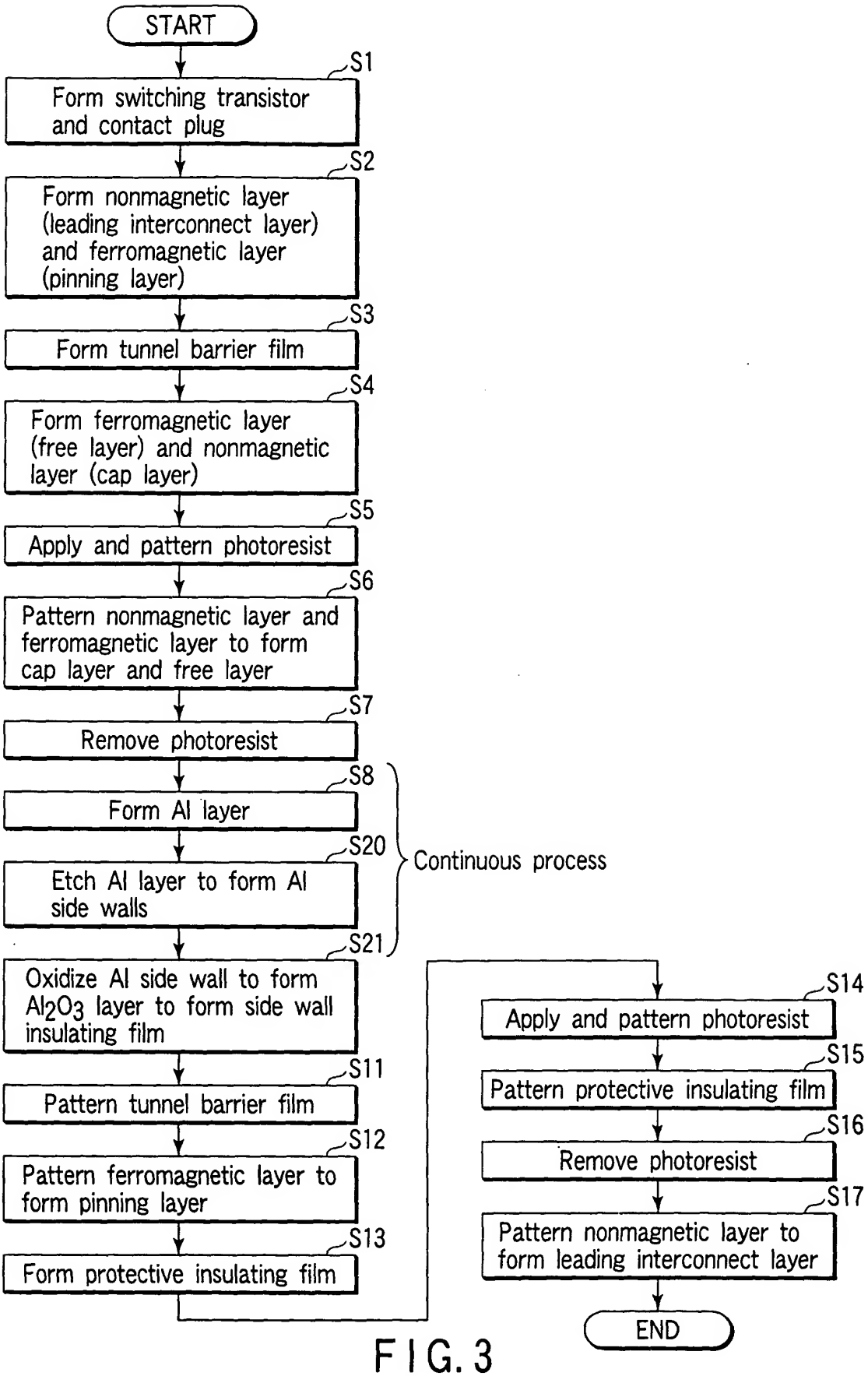
START
S1
Form switching transistor and contact plug
S2
Form nonmagnetic layer (leading interconnect layer) and ferromagnetic layer (pinning layer)
S3
Form tunnel barrier film
S4
Form ferromagnetic layer (free layer) and nonmagnetic layer (cap layer)
S5
Apply and pattern photoresist
S6
Pattern nonmagnetic layer and ferromagnetic layer to form cap layer and free layer
S7
Remove photoresist
S8
Form Al layer
S20
Etch Al layer to form Al side walls
S21
Oxidize Al side wall to form Al_2O_3 layer to form side wall insulating film
S11
Pattern tunnel barrier film
S12
Pattern ferromagnetic layer to form pinning layer
S13
Form protective insulating film
Continuous process
S14
Apply and pattern photoresist
S15
Pattern protective insulating film
S16
Remove photoresist
S17
Pattern nonmagnetic layer to form leading interconnect layer
END

FIG. 3

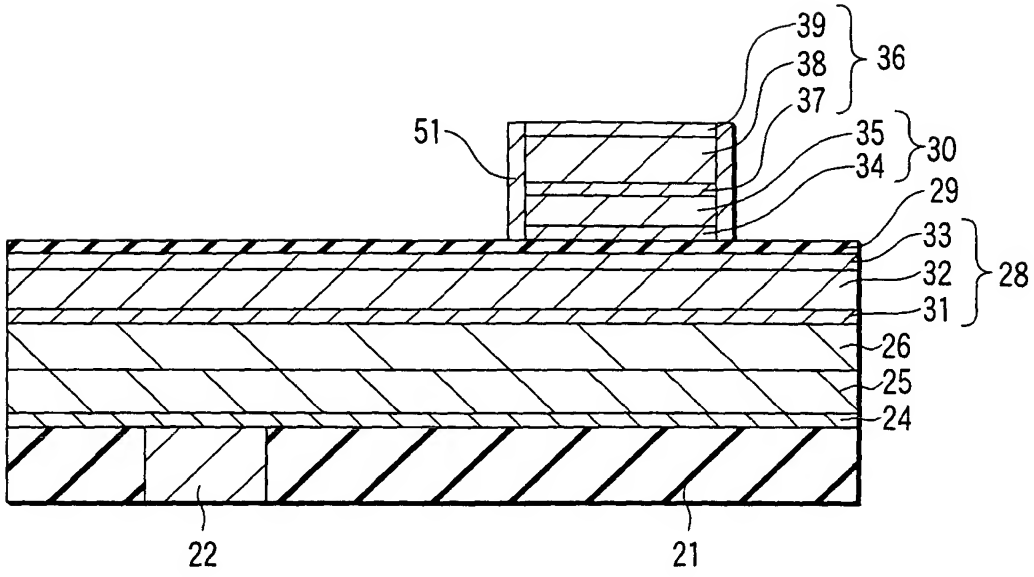
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FIG. 4A

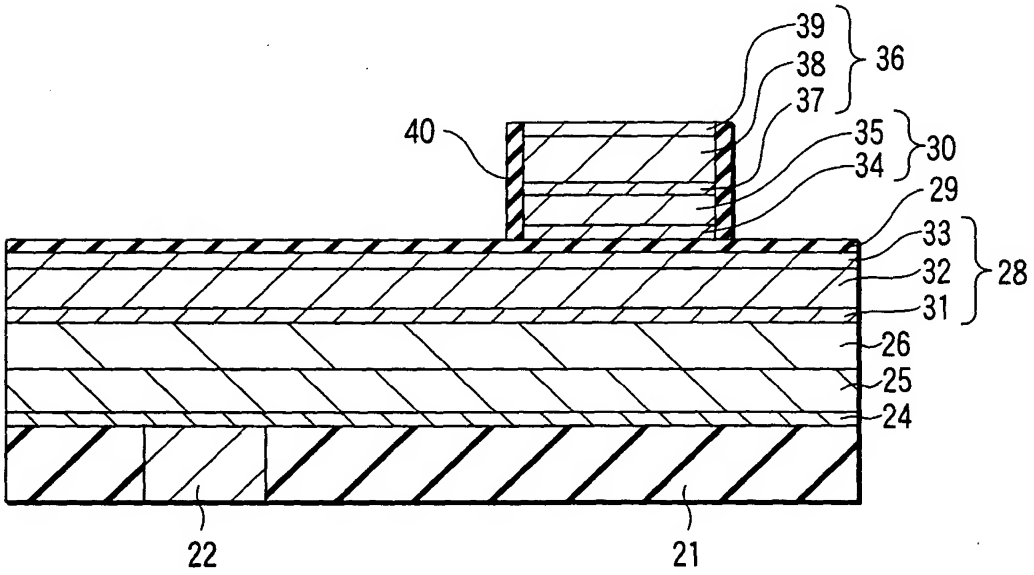
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FIG. 4B

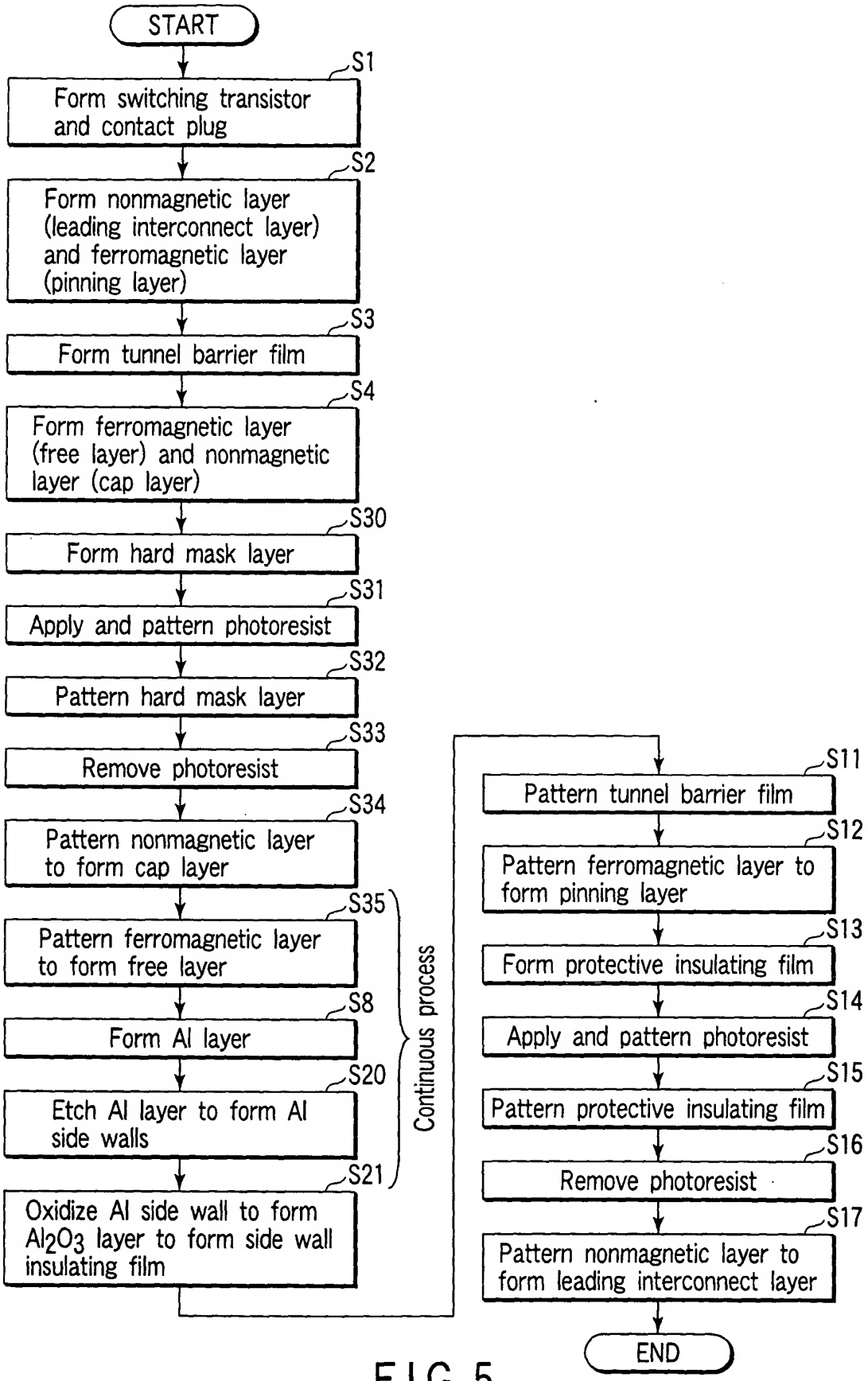

START
S1
Form switching transistor and contact plug
S2
Form nonmagnetic layer (leading interconnect layer) and ferromagnetic layer (pinning layer)
S3
Form tunnel barrier film
S4
Form ferromagnetic layer (free layer) and nonmagnetic layer (cap layer)
S30
Form hard mask layer
S31
Apply and pattern photoresist
S32
Pattern hard mask layer
S33
Remove photoresist
S34
Pattern nonmagnetic layer to form cap layer
S35
Pattern ferromagnetic layer to form free layer
S8
Form Al layer
S20
Etch Al layer to form Al side walls
S21
Oxidize Al side wall to form Al_2O_3 layer to form side wall insulating film
Continuous process
S11
Pattern tunnel barrier film
S12
Pattern ferromagnetic layer to form pinning layer
S13
Form protective insulating film
S14
Apply and pattern photoresist
S15
Pattern protective insulating film
S16
Remove photoresist
S17
Pattern nonmagnetic layer to form leading interconnect layer
END

FIG. 5

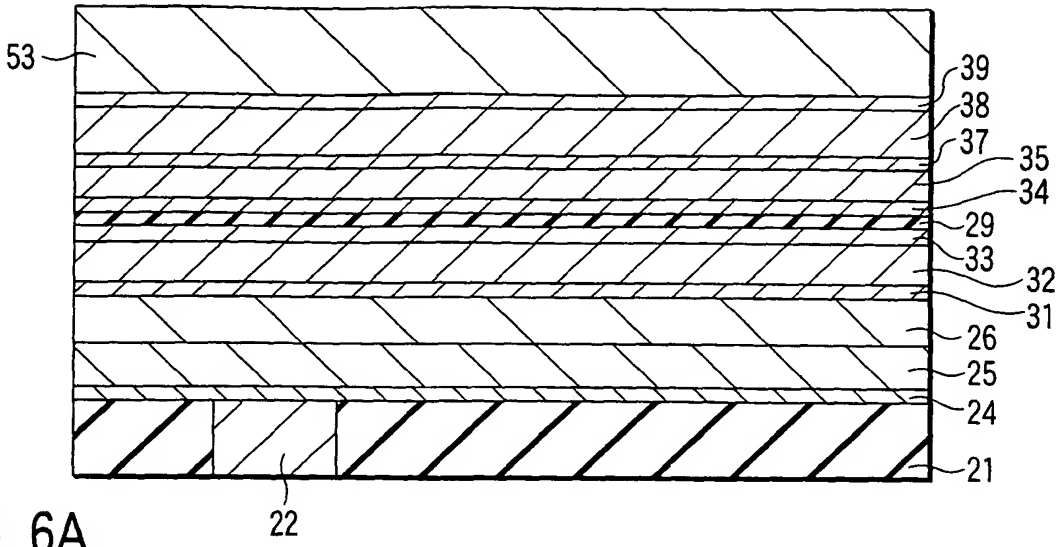


FIG. 6A

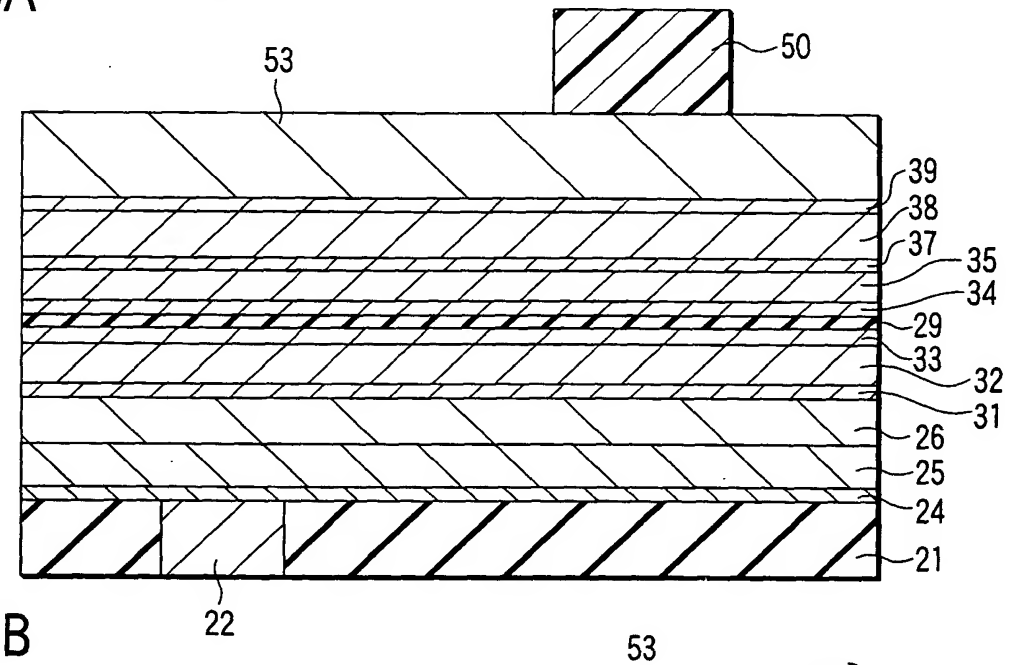


FIG. 6B

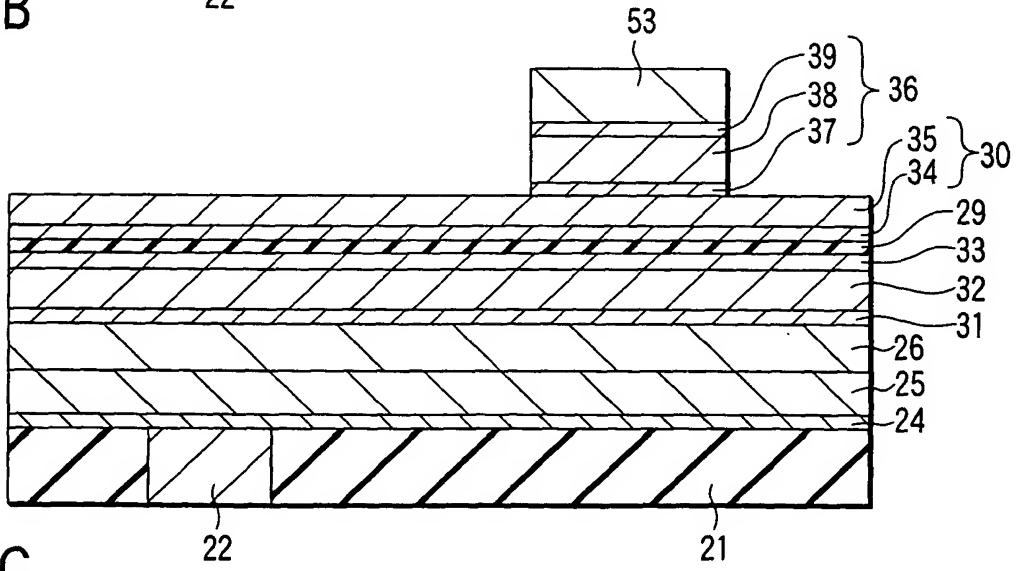


FIG. 6C

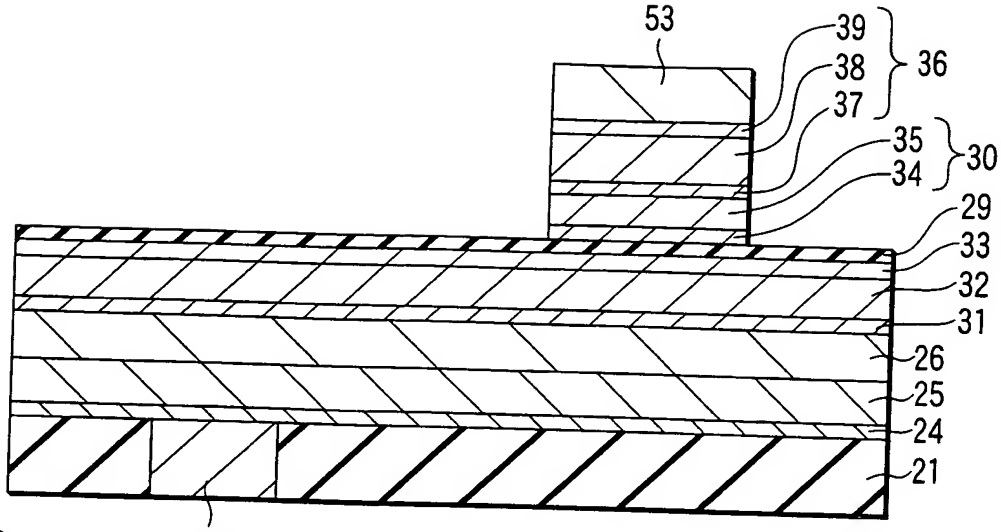


FIG. 6D

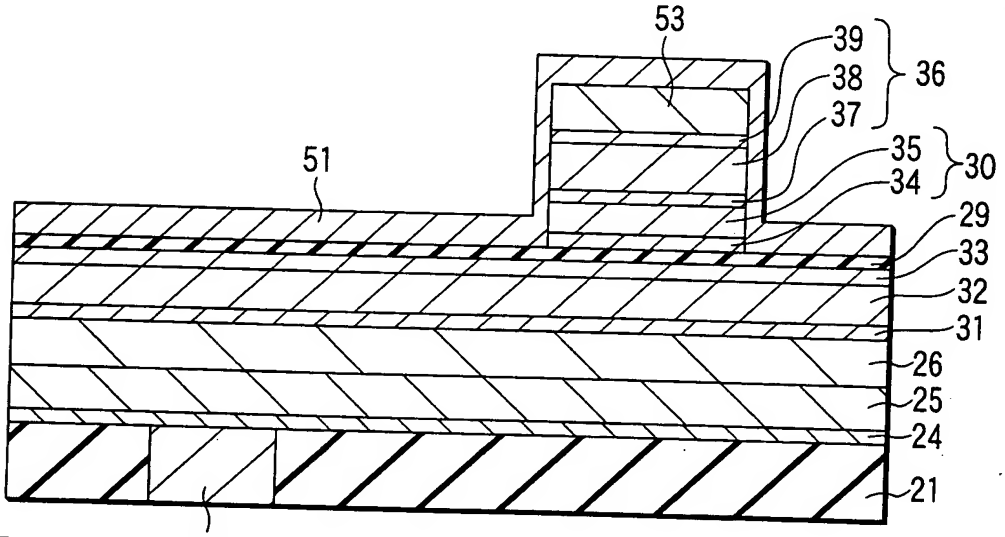


FIG. 6E

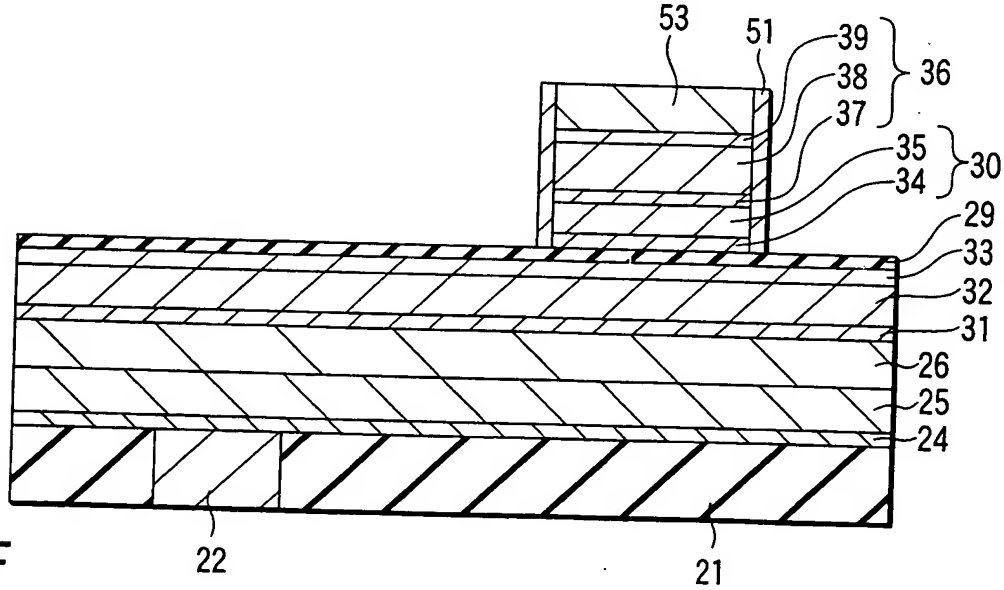


FIG. 6F

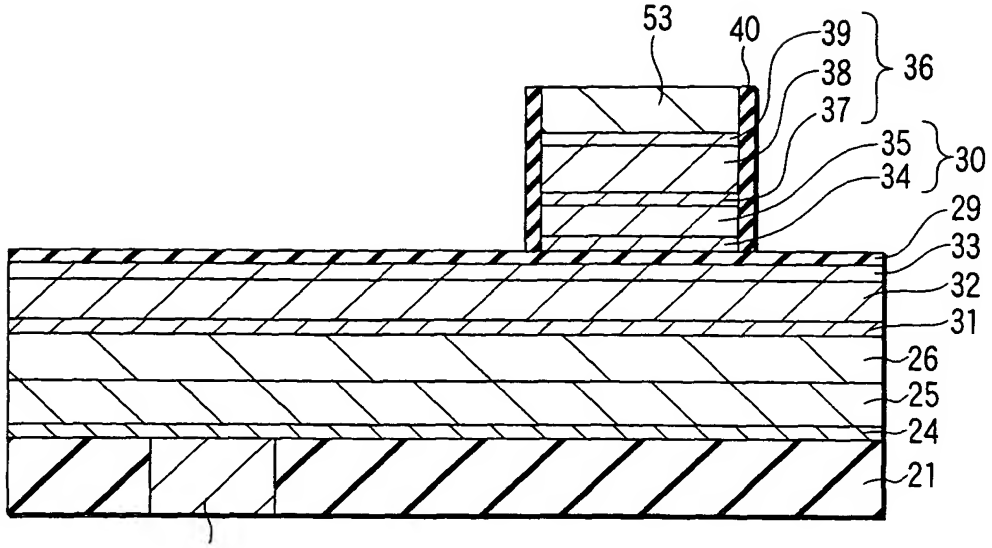


FIG. 6G

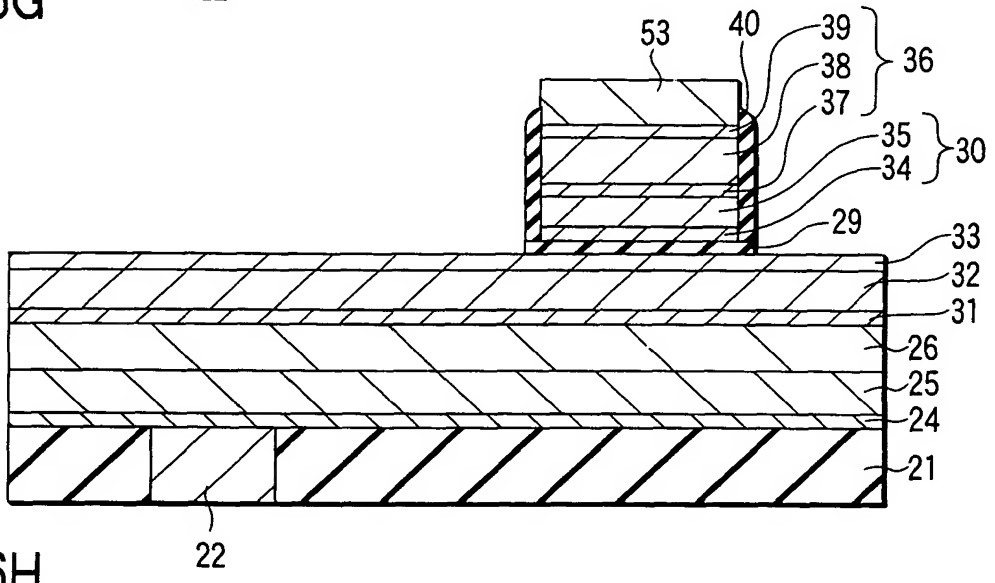


FIG. 6H

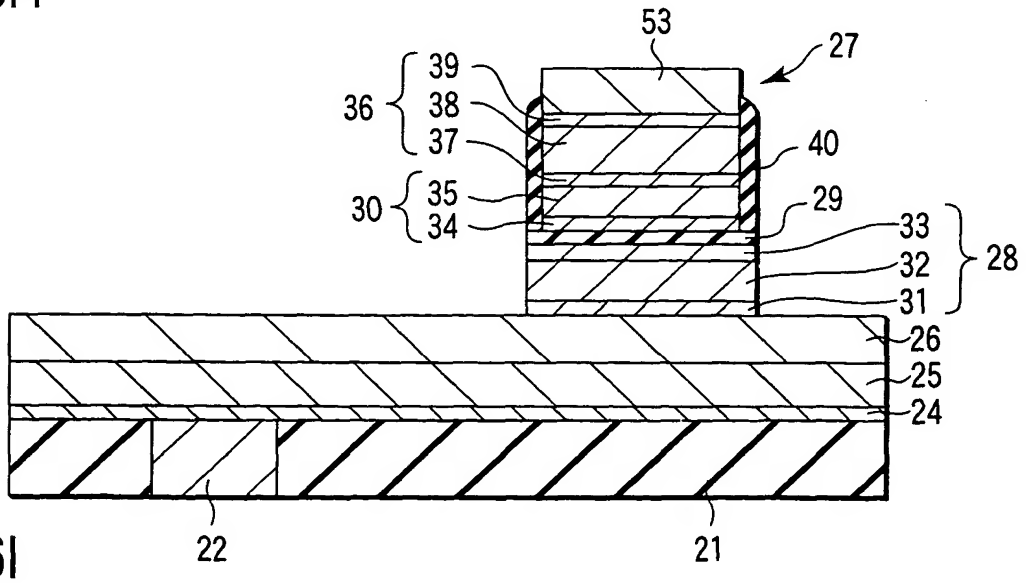


FIG. 6I

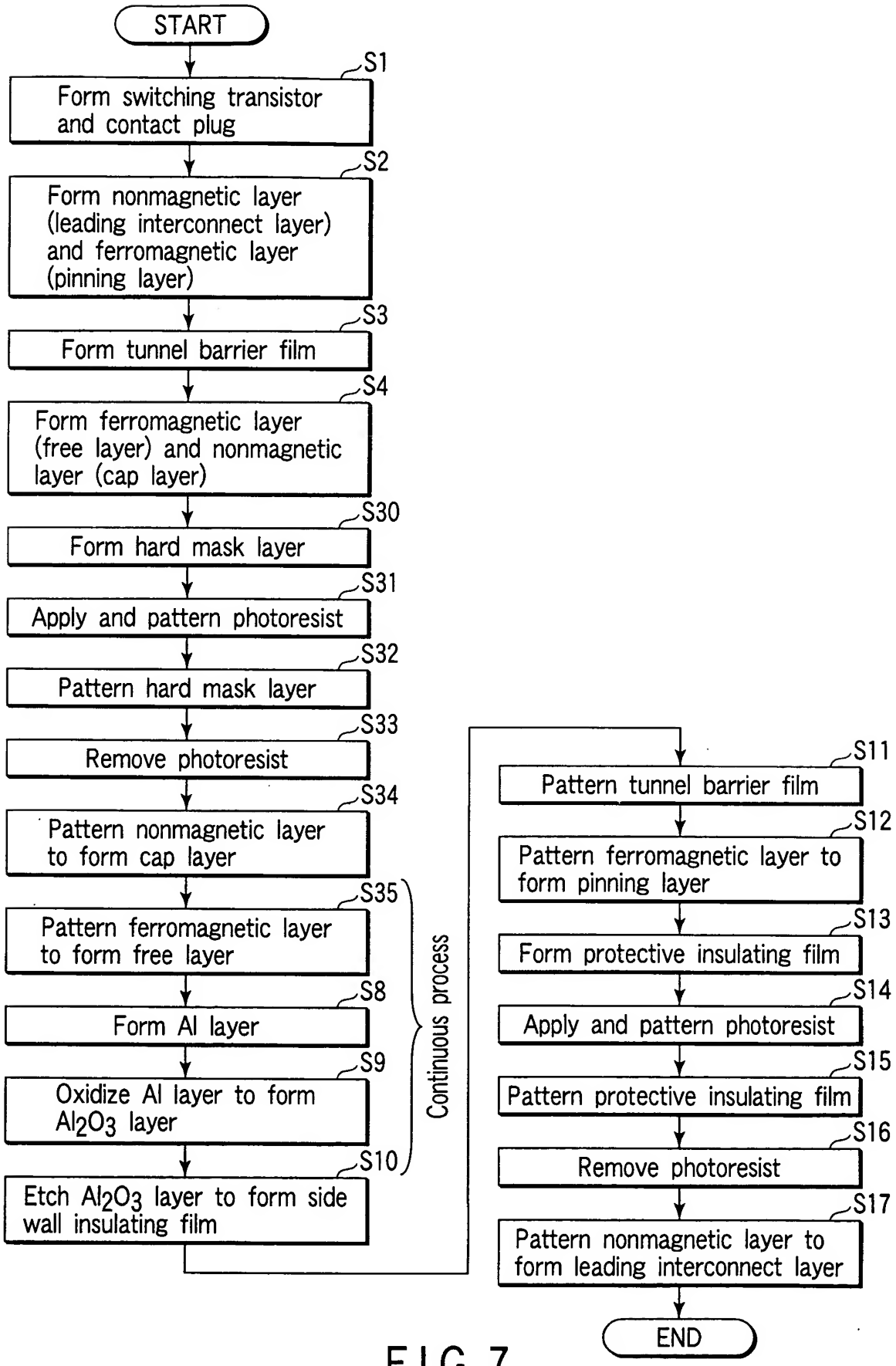

START
S1
Form switching transistor and contact plug
S2
Form nonmagnetic layer (leading interconnect layer) and ferromagnetic layer (pinning layer)
S3
Form tunnel barrier film
S4
Form ferromagnetic layer (free layer) and nonmagnetic layer (cap layer)
S30
Form hard mask layer
S31
Apply and pattern photoresist
S32
Pattern hard mask layer
S33
Remove photoresist
S34
Pattern nonmagnetic layer to form cap layer
S35
Pattern ferromagnetic layer to form free layer
S8
Form Al layer
S9
Oxidize Al layer to form Al_2O_3 layer
S10
Etch Al_2O_3 layer to form side wall insulating film
Continuous process
S11
Pattern tunnel barrier film
S12
Pattern ferromagnetic layer to form pinning layer
S13
Form protective insulating film
S14
Apply and pattern photoresist
S15
Pattern protective insulating film
S16
Remove photoresist
S17
Pattern nonmagnetic layer to form leading interconnect layer
END

FIG. 7

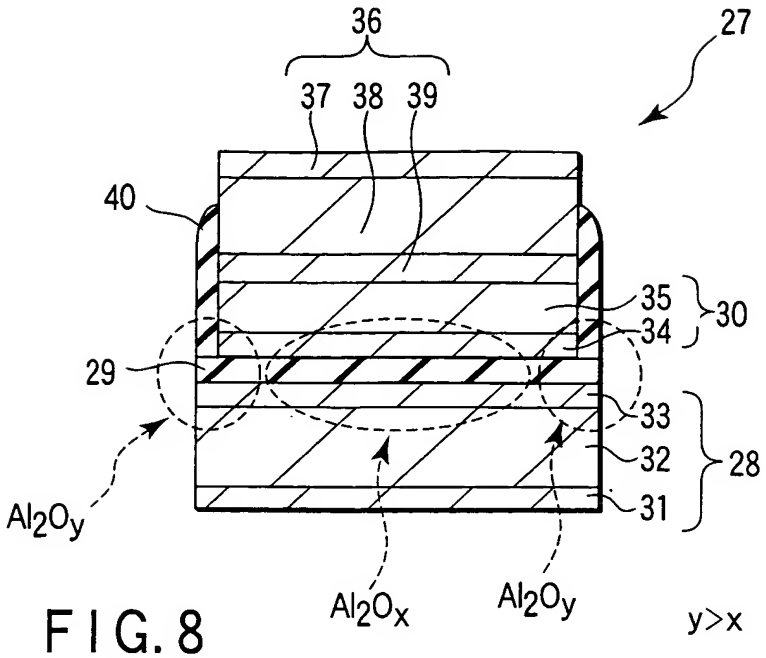


FIG. 8

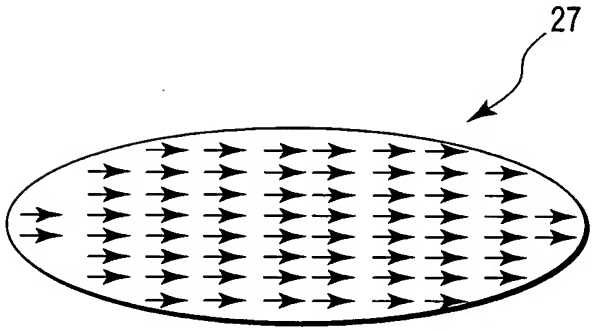


FIG. 9A

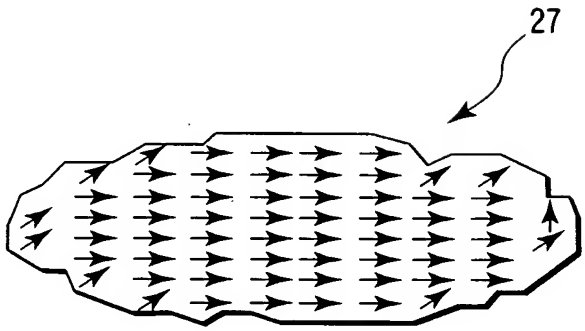


FIG. 9B

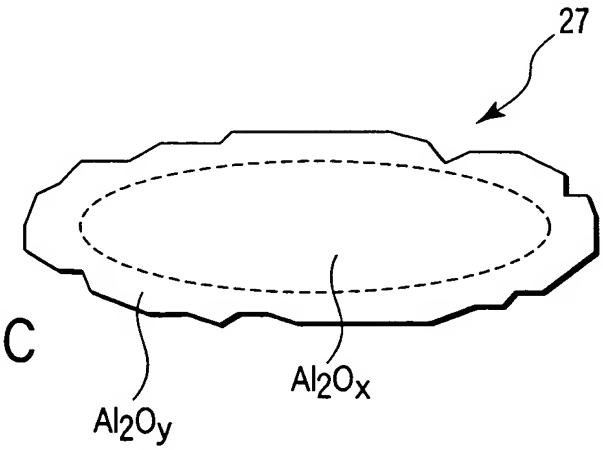


FIG. 9C

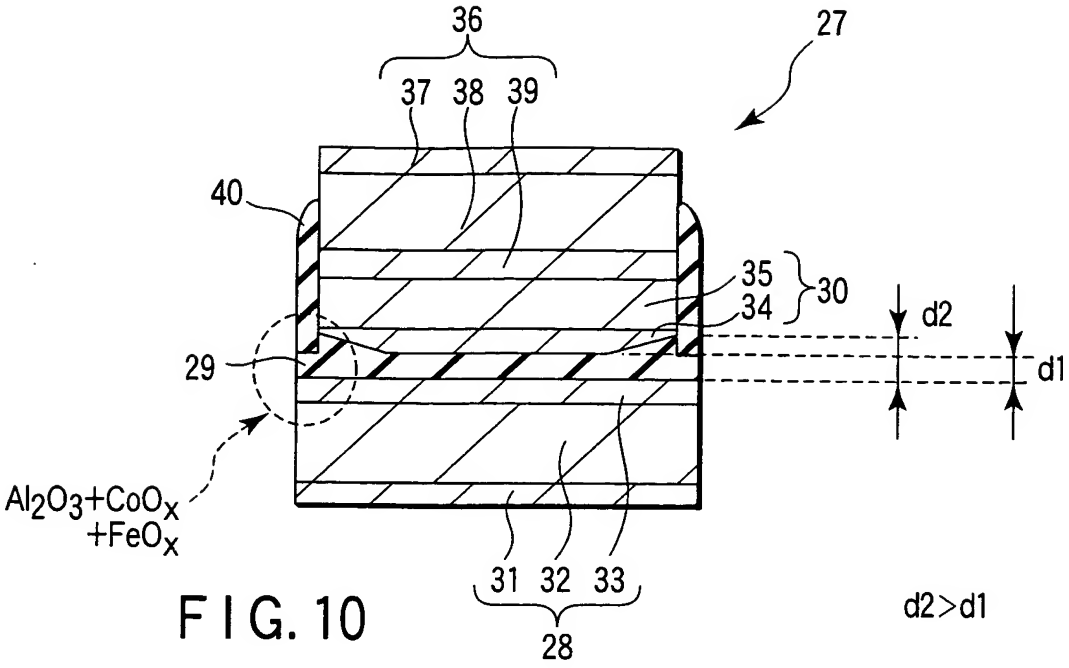


FIG. 10

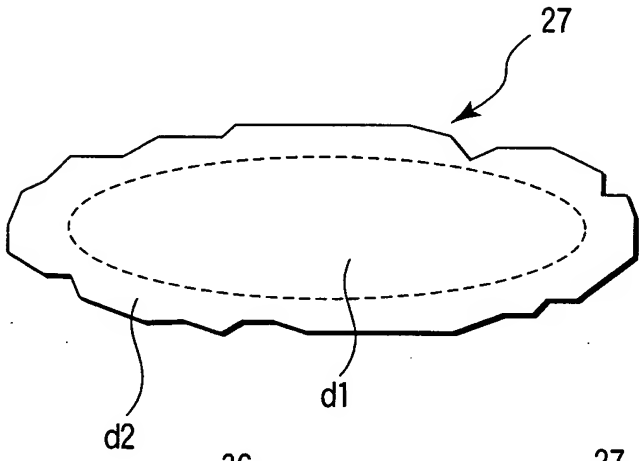


FIG. 11

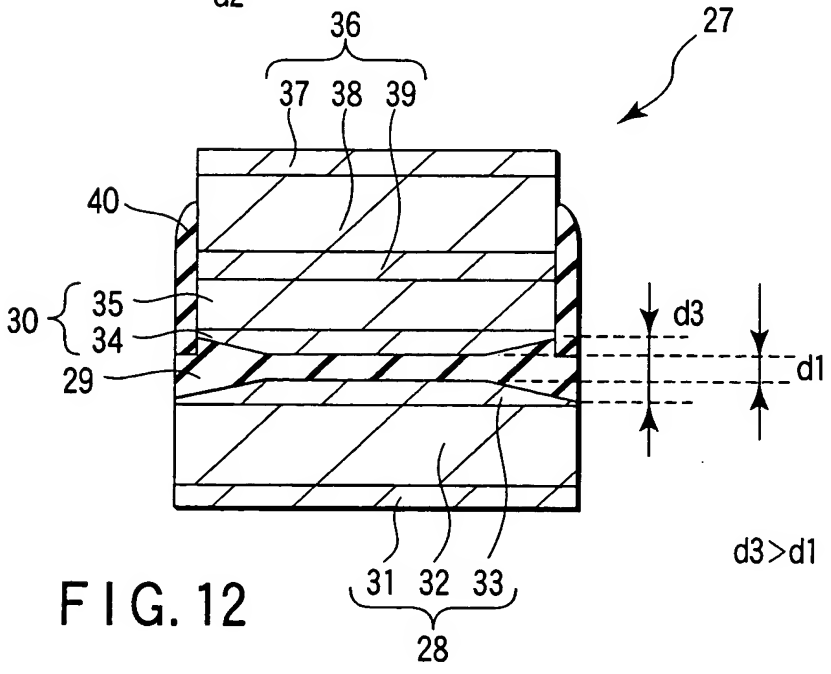


FIG. 12

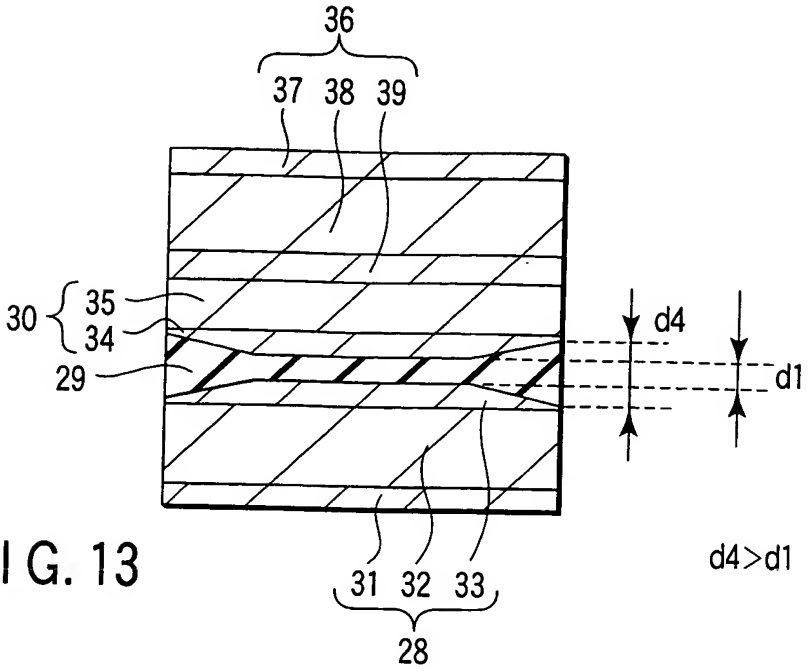


FIG. 13

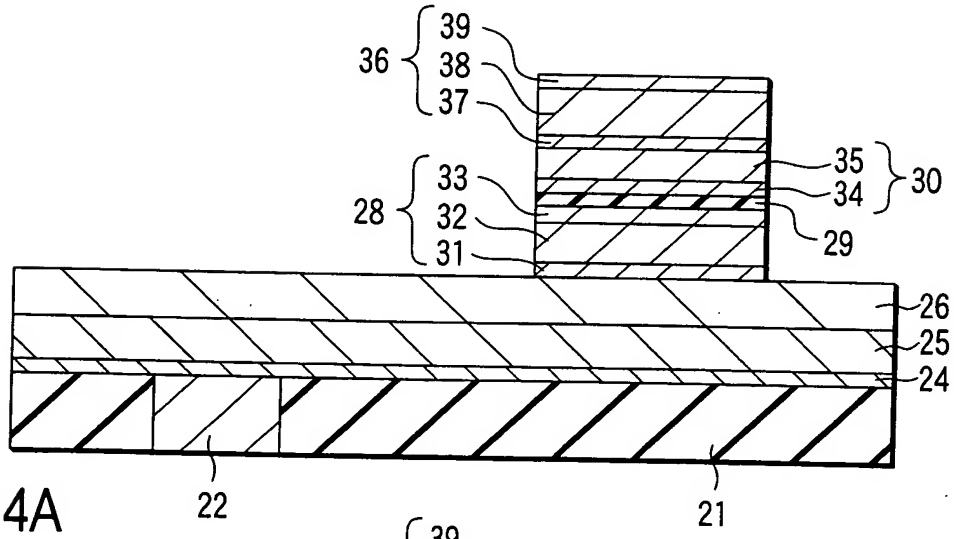


FIG. 14A

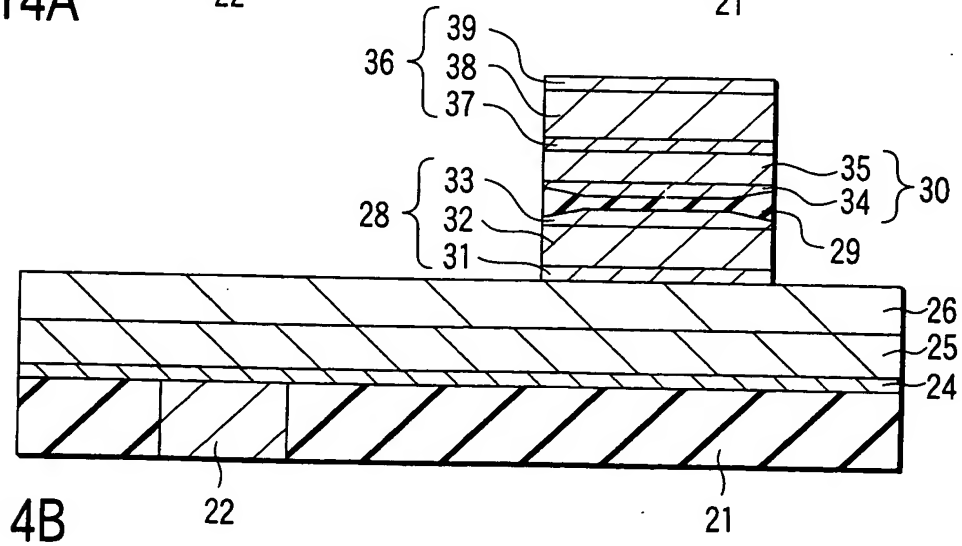
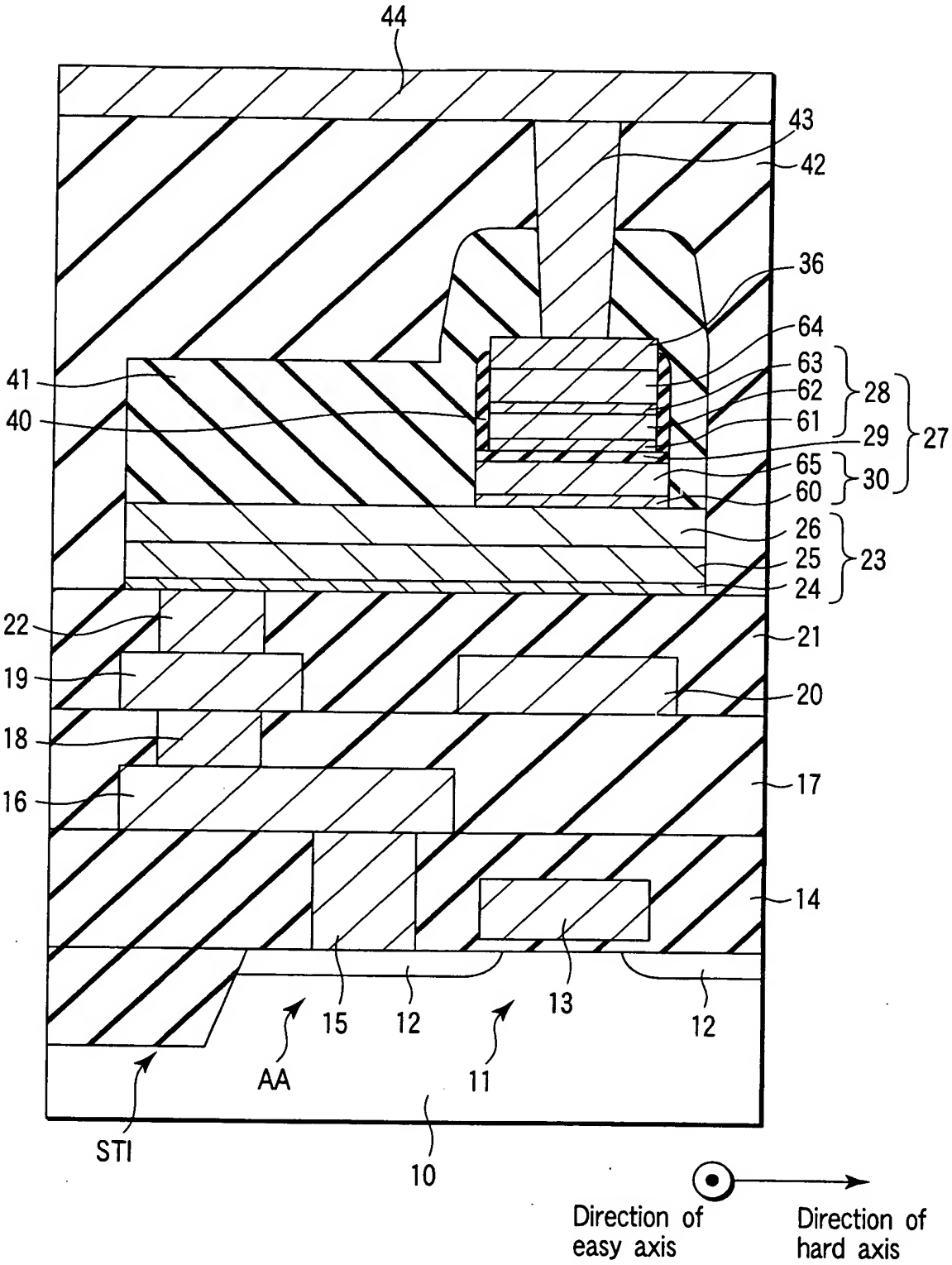


FIG. 14B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AA
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STI
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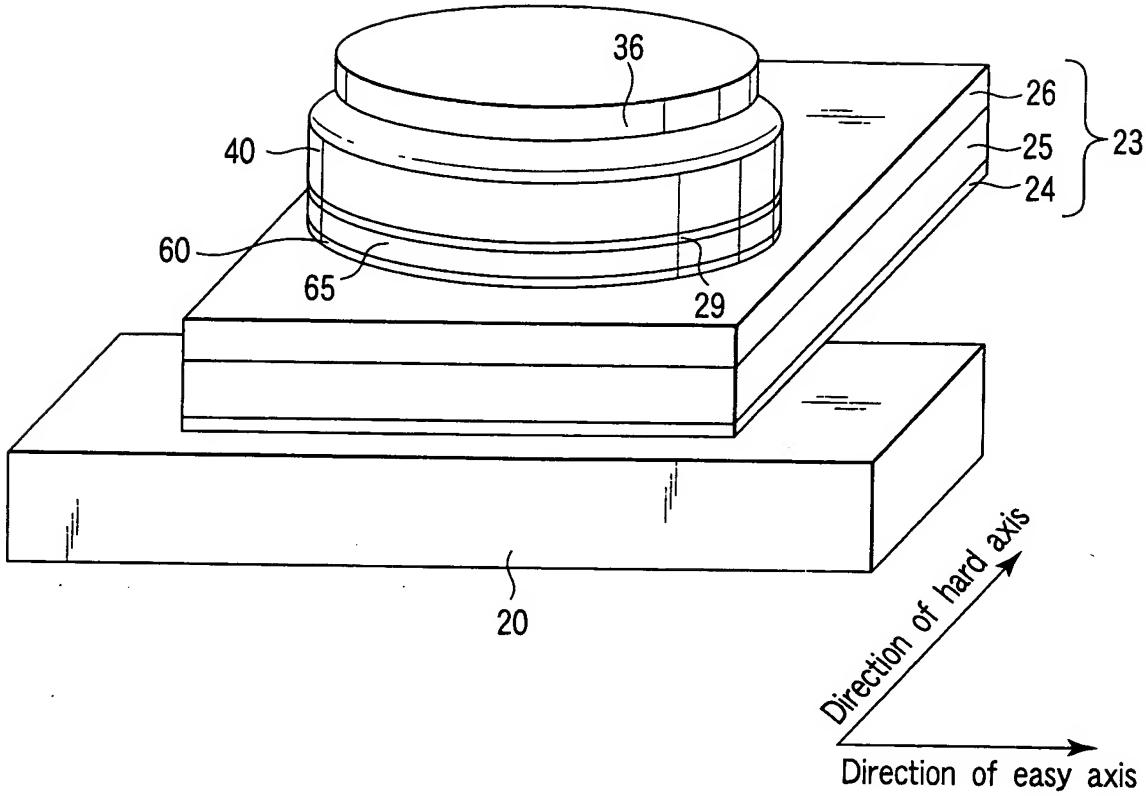
Direction of easy axis
Direction of hard axis

FIG. 15A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Direction of hard axis
Direction of easy axis

FIG. 15B

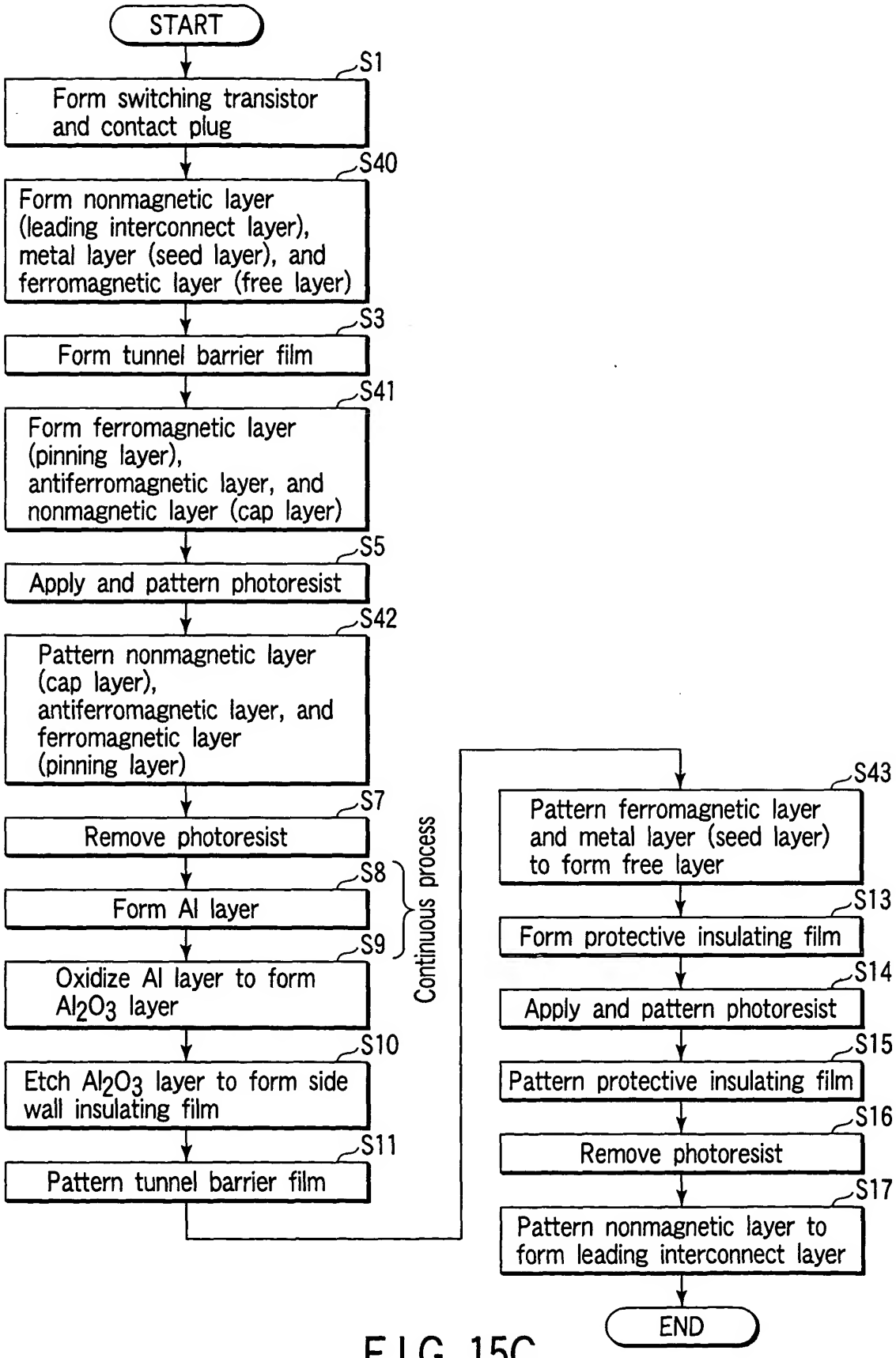

START
S1
Form switching transistor and contact plug
S40
Form nonmagnetic layer (leading interconnect layer), metal layer (seed layer), and ferromagnetic layer (free layer)
S3
Form tunnel barrier film
S41
Form ferromagnetic layer (pinning layer), antiferromagnetic layer, and nonmagnetic layer (cap layer)
S5
Apply and pattern photoresist
S42
Pattern nonmagnetic layer (cap layer), antiferromagnetic layer, and ferromagnetic layer (pinning layer)
S7
Remove photoresist
S8
Form Al layer
S9
Oxidize Al layer to form Al_2O_3 layer
S10
Etch Al_2O_3 layer to form side wall insulating film
S11
Pattern tunnel barrier film
Continuous process
S43
Pattern ferromagnetic layer and metal layer (seed layer) to form free layer
S13
Form protective insulating film
S14
Apply and pattern photoresist
S15
Pattern protective insulating film
S16
Remove photoresist
S17
Pattern nonmagnetic layer to form leading interconnect layer
END

FIG. 15C

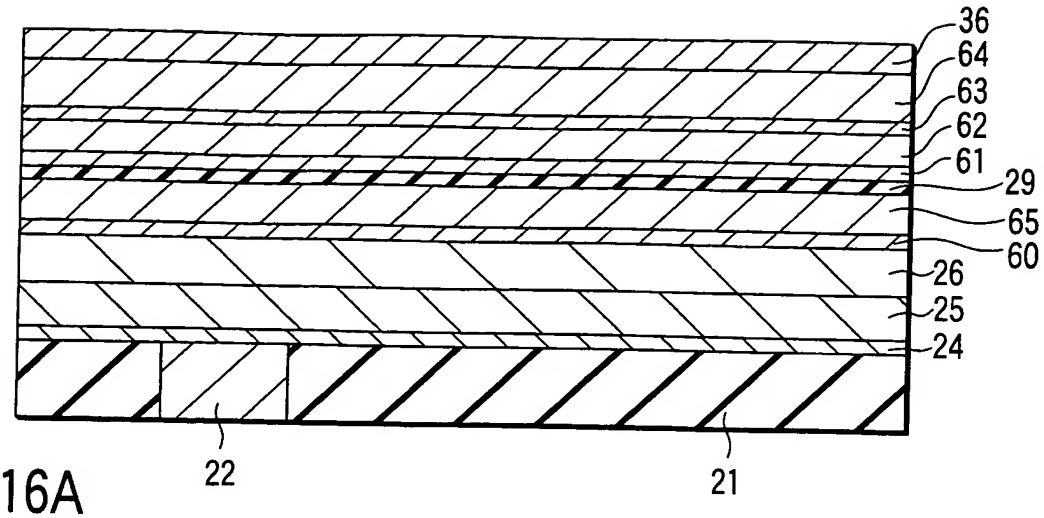


FIG. 16A

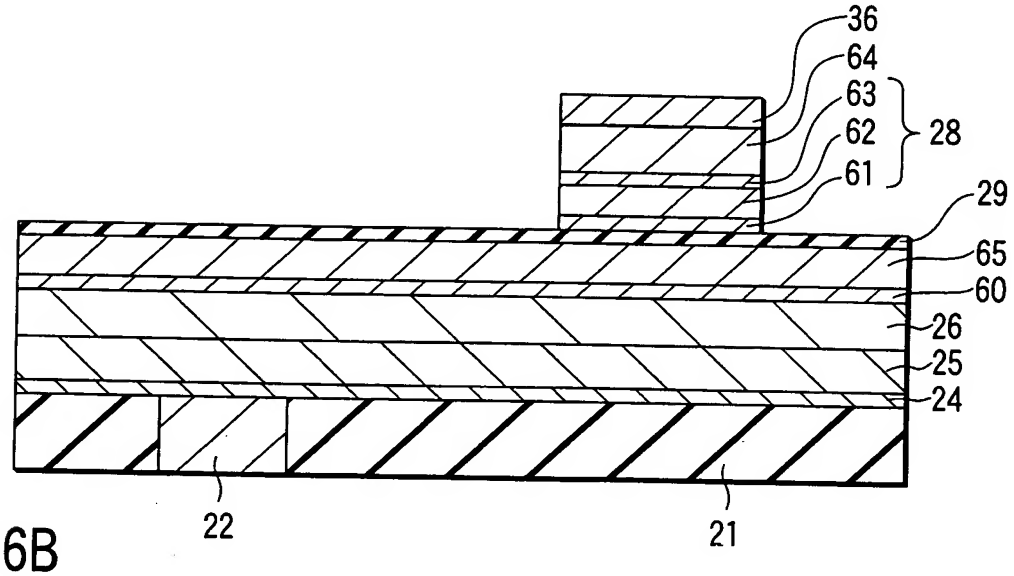


FIG. 16B

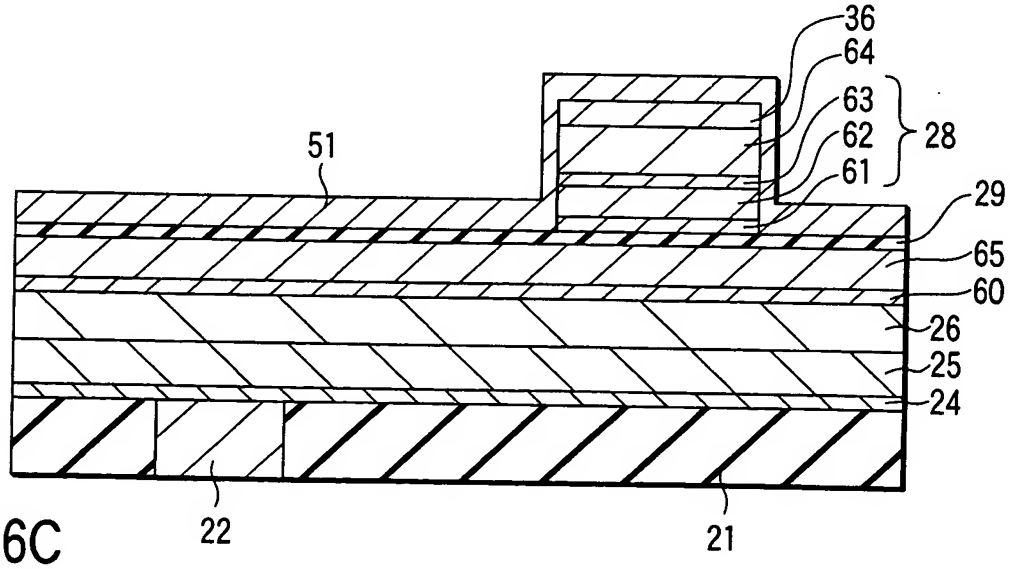


FIG. 16C

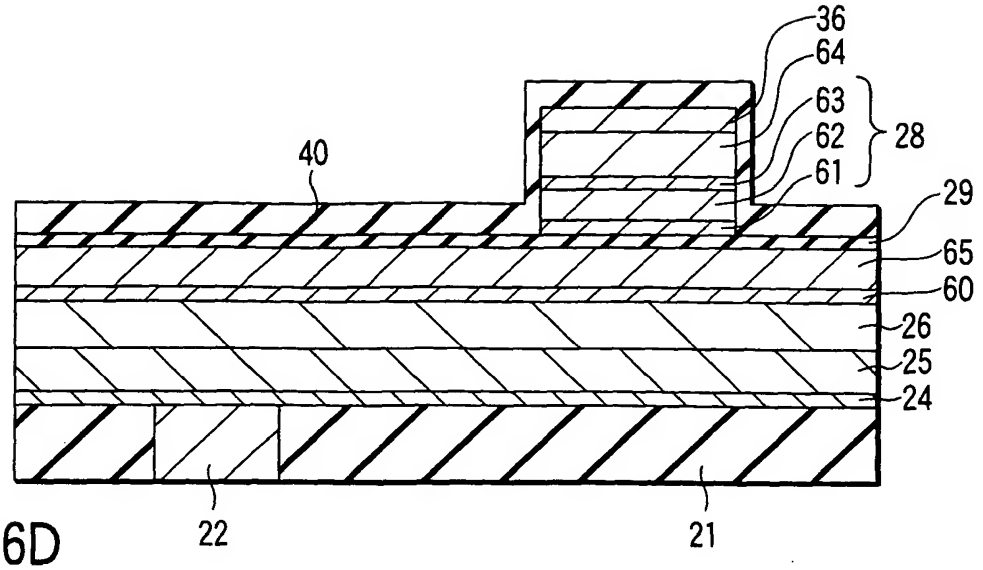


FIG. 16D

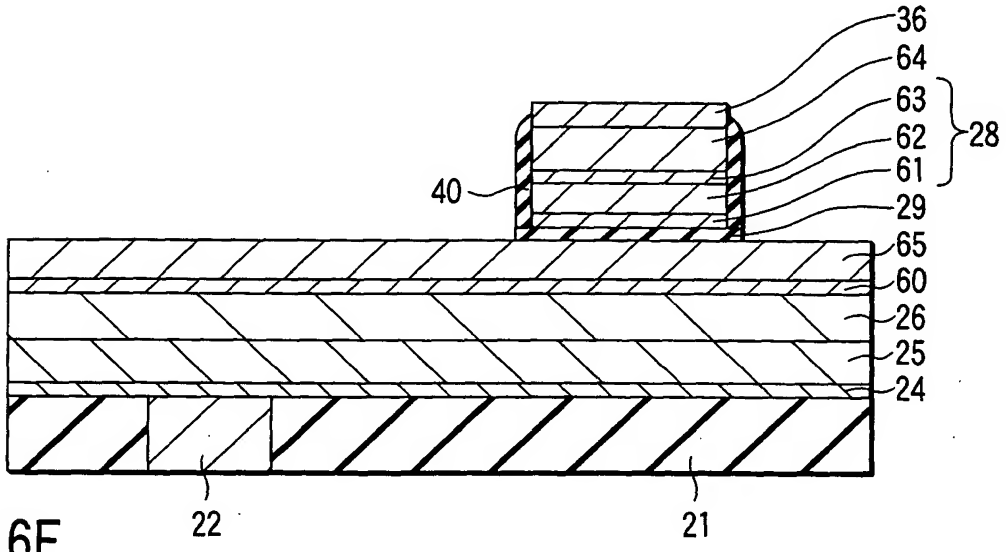


FIG. 16E

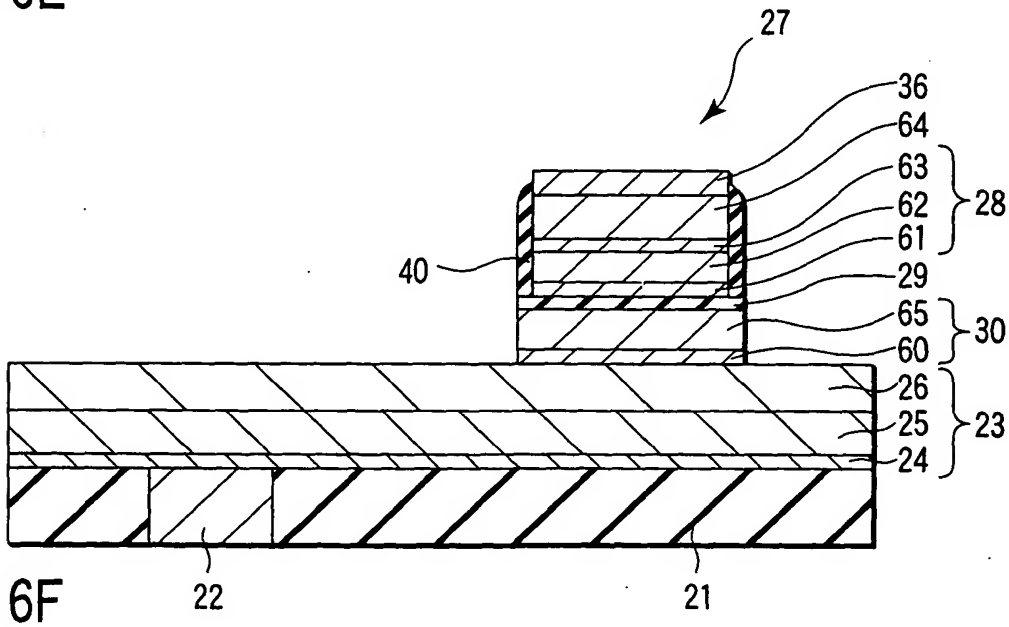


FIG. 16F

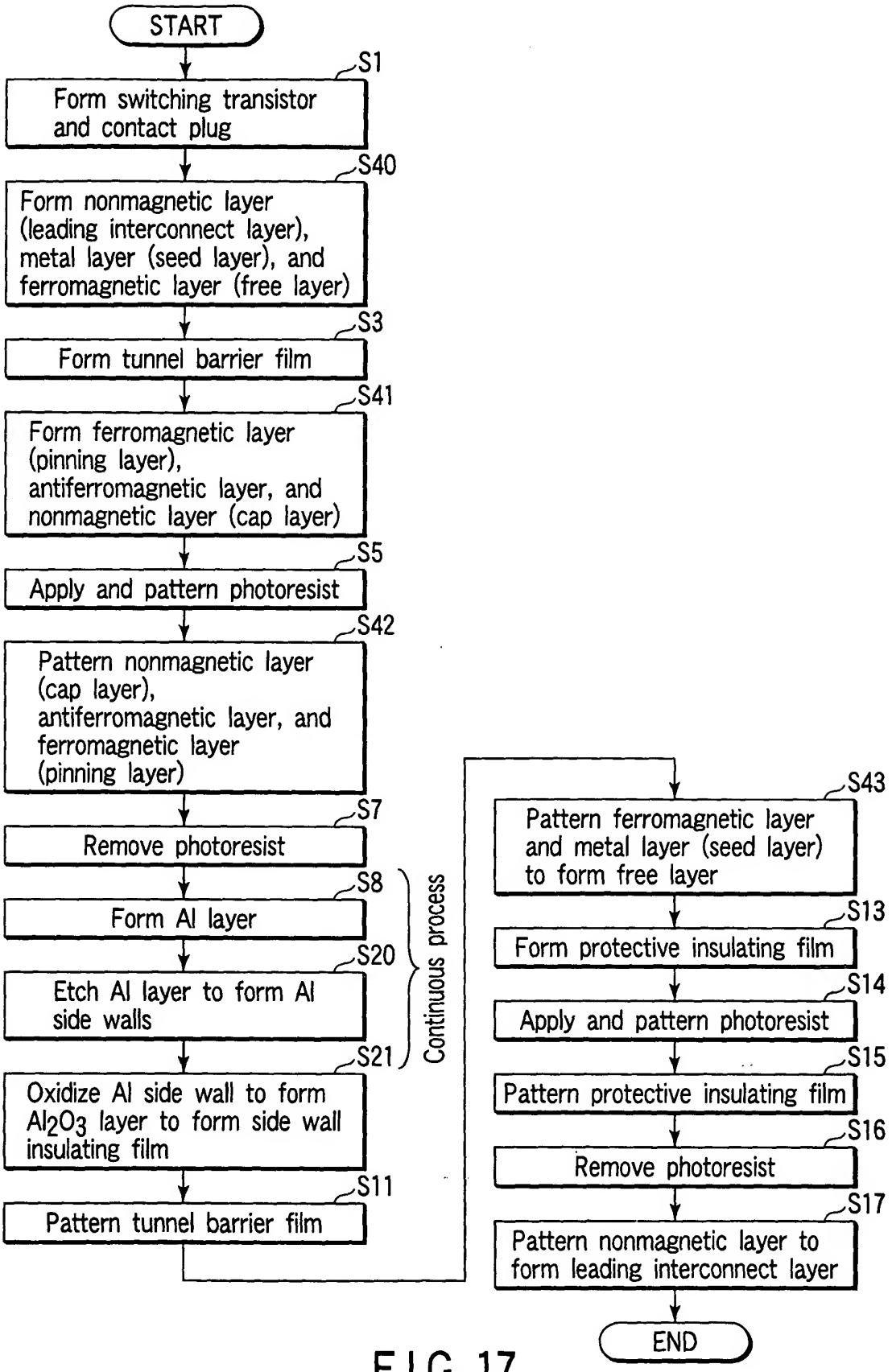

START
S1
Form switching transistor and contact plug
S40
Form nonmagnetic layer (leading interconnect layer), metal layer (seed layer), and ferromagnetic layer (free layer)
S3
Form tunnel barrier film
S41
Form ferromagnetic layer (pinning layer), antiferromagnetic layer, and nonmagnetic layer (cap layer)
S5
Apply and pattern photoresist
S42
Pattern nonmagnetic layer (cap layer), antiferromagnetic layer, and ferromagnetic layer (pinning layer)
S7
Remove photoresist
S8
Form Al layer
S20
Etch Al layer to form Al side walls
S21
Oxidize Al side wall to form Al_2O_3 layer to form side wall insulating film
S11
Pattern tunnel barrier film
Continuous process
S43
Pattern ferromagnetic layer and metal layer (seed layer) to form free layer
S13
Form protective insulating film
S14
Apply and pattern photoresist
S15
Pattern protective insulating film
S16
Remove photoresist
S17
Pattern nonmagnetic layer to form leading interconnect layer
END

FIG. 17

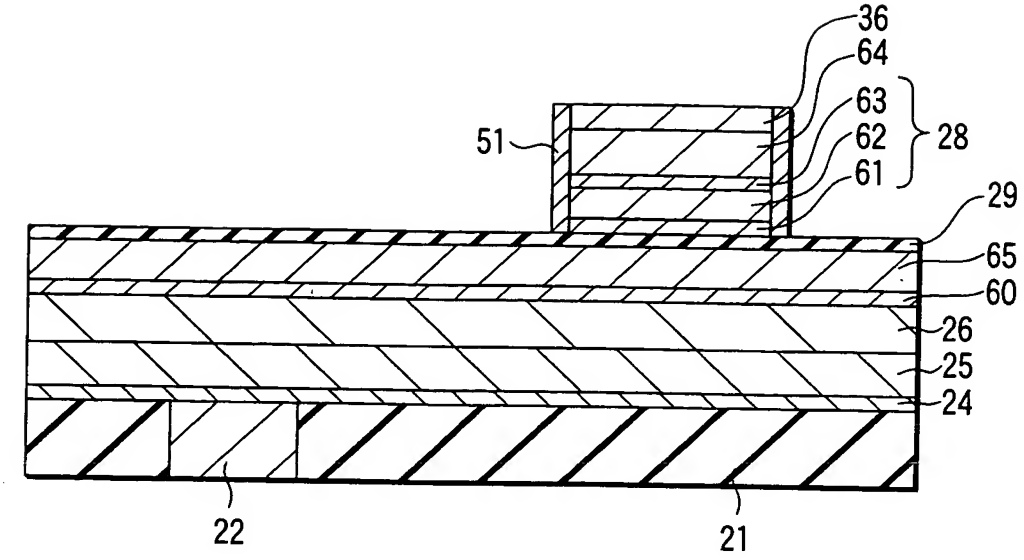


FIG. 18A

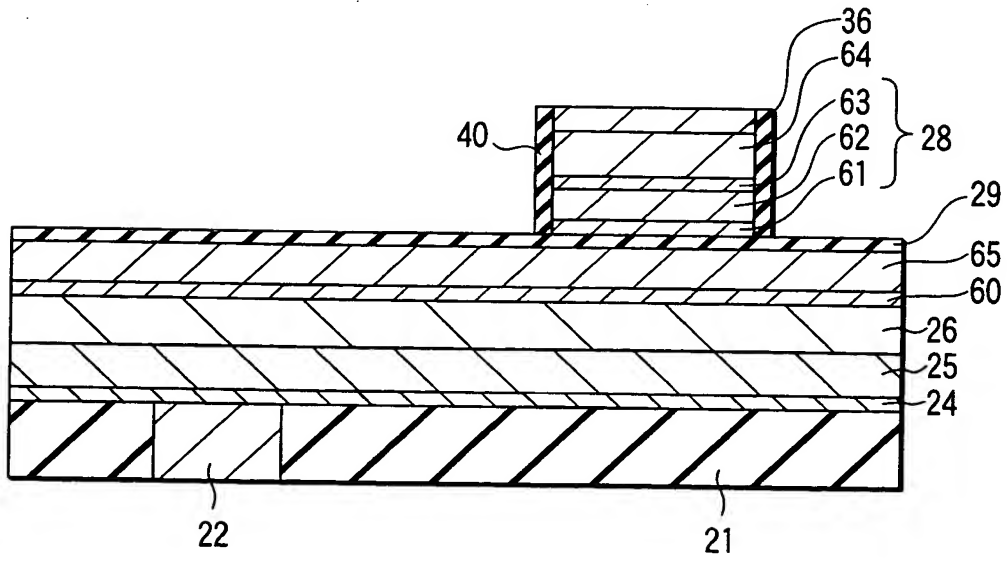


FIG. 18B

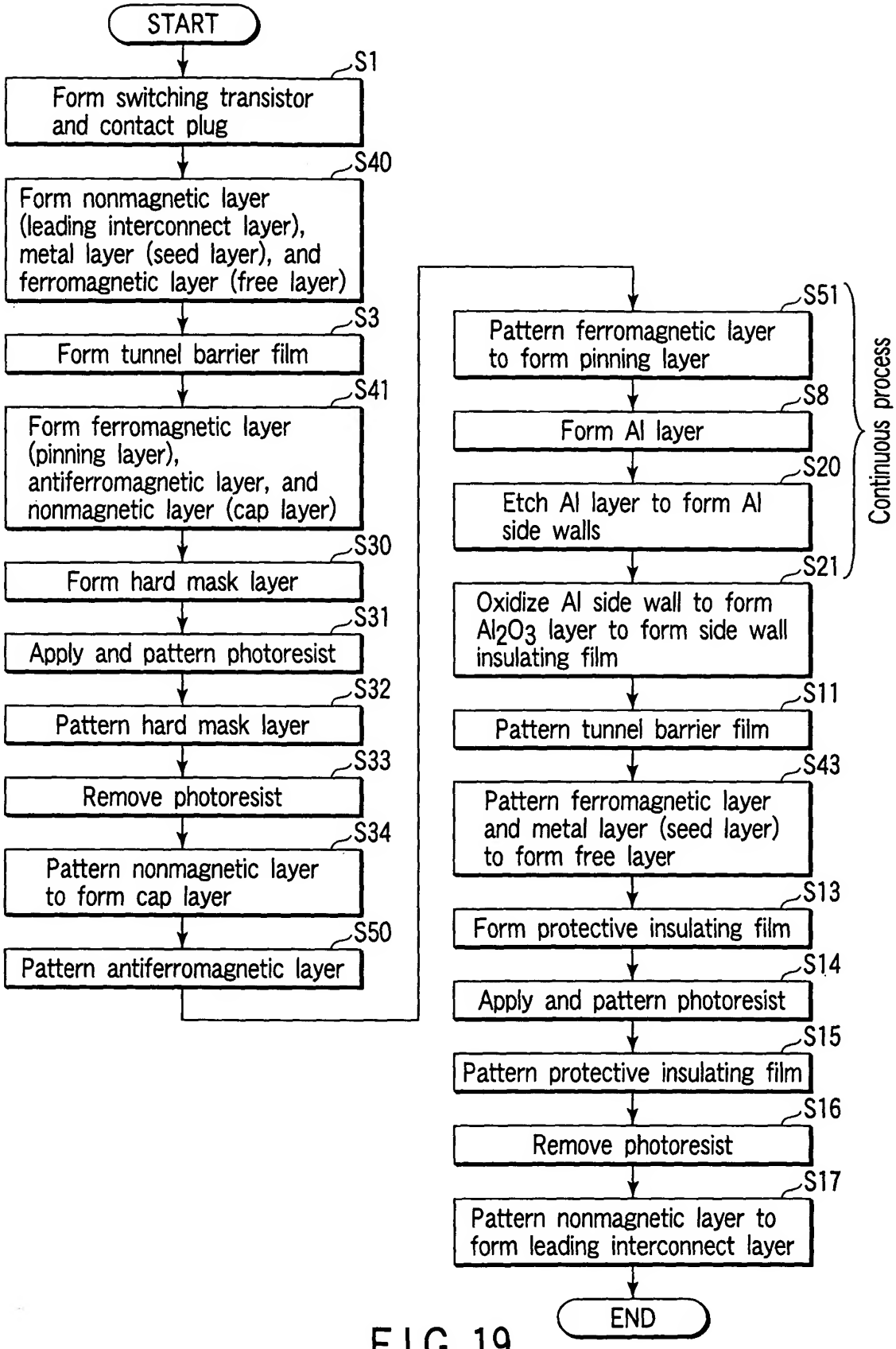

START
S1
Form switching transistor and contact plug
S40
Form nonmagnetic layer (leading interconnect layer), metal layer (seed layer), and ferromagnetic layer (free layer)
S3
Form tunnel barrier film
S41
Form ferromagnetic layer (pinning layer), antiferromagnetic layer, and nonmagnetic layer (cap layer)
S30
Form hard mask layer
S31
Apply and pattern photoresist
S32
Pattern hard mask layer
S33
Remove photoresist
S34
Pattern nonmagnetic layer to form cap layer
S50
Pattern antiferromagnetic layer
S51
Pattern ferromagnetic layer to form pinning layer
S8
Form Al layer
S20
Etch Al layer to form Al side walls
S21
Oxidize Al side wall to form Al_2O_3 layer to form side wall insulating film
S11
Pattern tunnel barrier film
S43
Pattern ferromagnetic layer and metal layer (seed layer) to form free layer
S13
Form protective insulating film
S14
Apply and pattern photoresist
S15
Pattern protective insulating film
S16
Remove photoresist
S17
Pattern nonmagnetic layer to form leading interconnect layer
END
Continuous process

FIG. 19

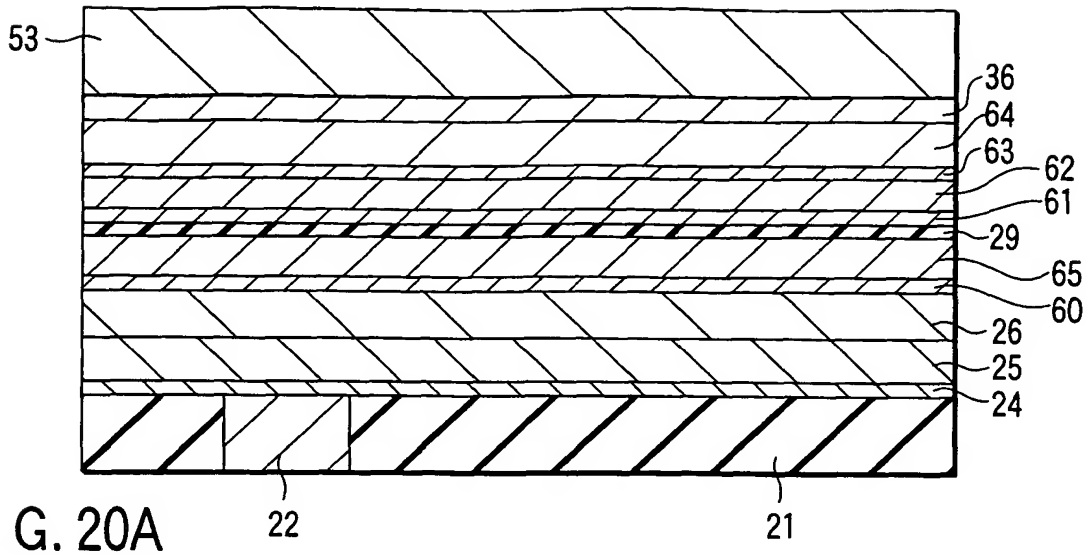


FIG. 20A

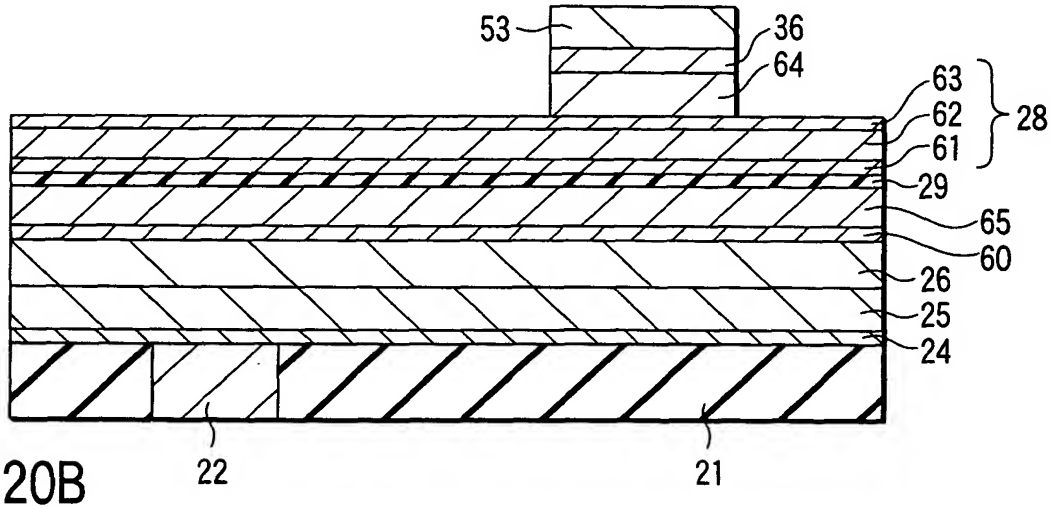


FIG. 20B

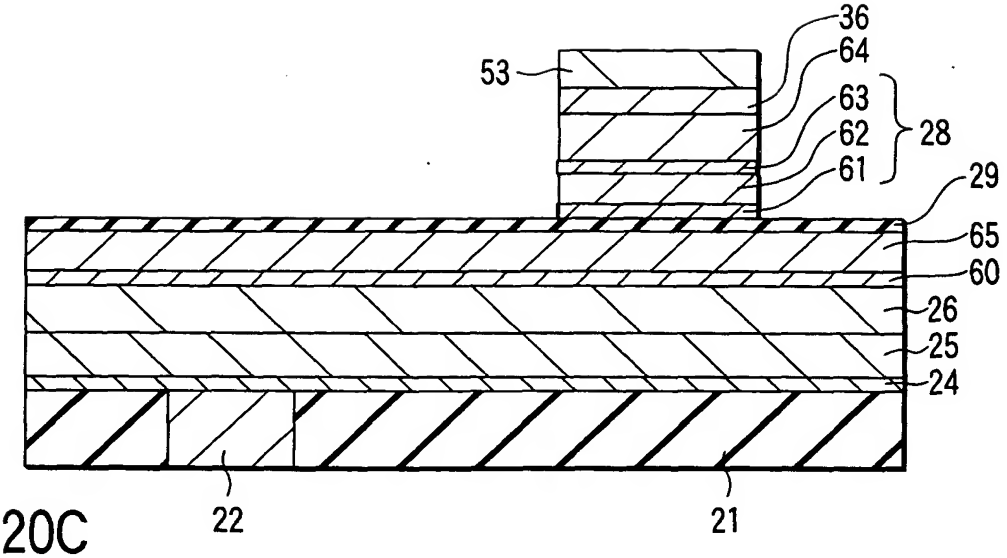


FIG. 20C

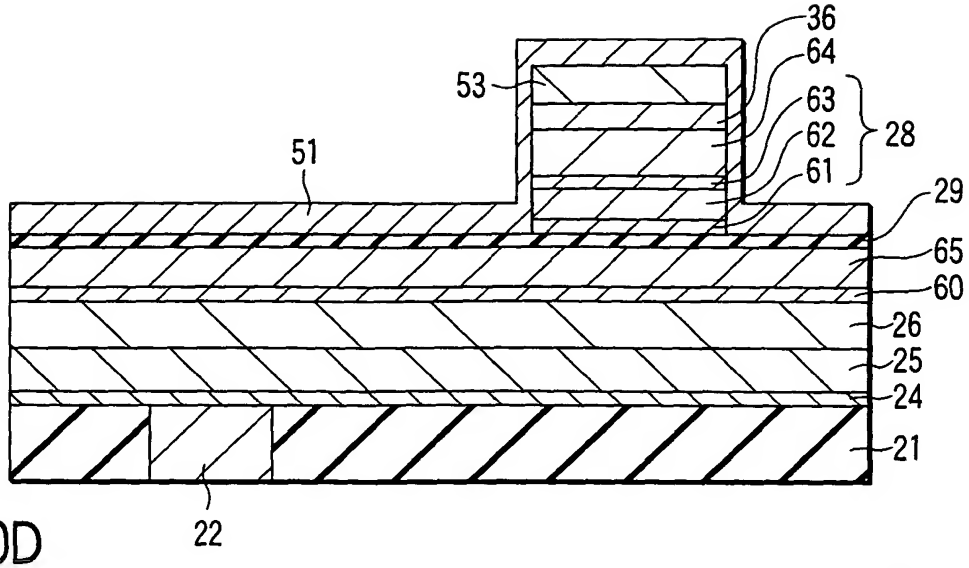


FIG. 20D

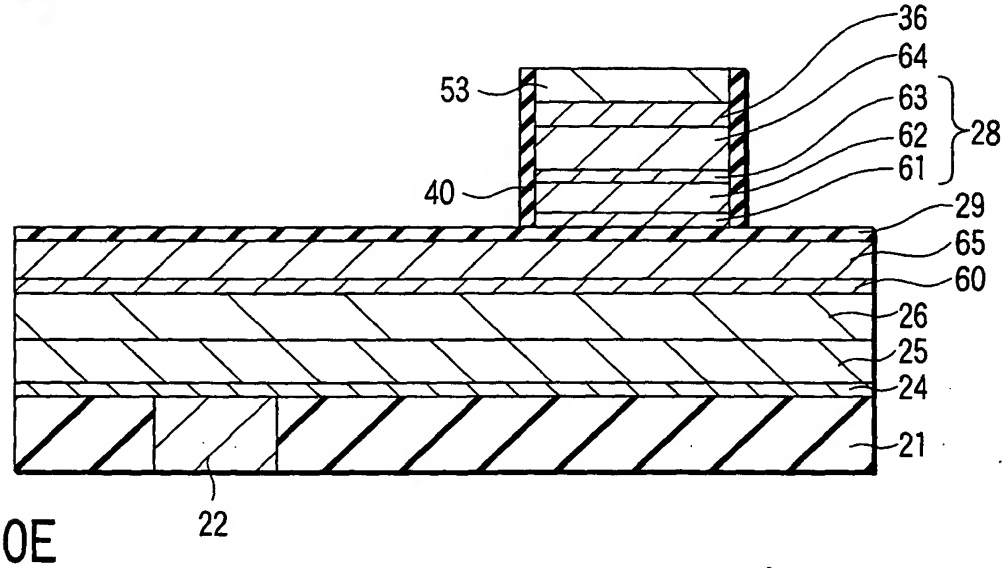


FIG. 20E

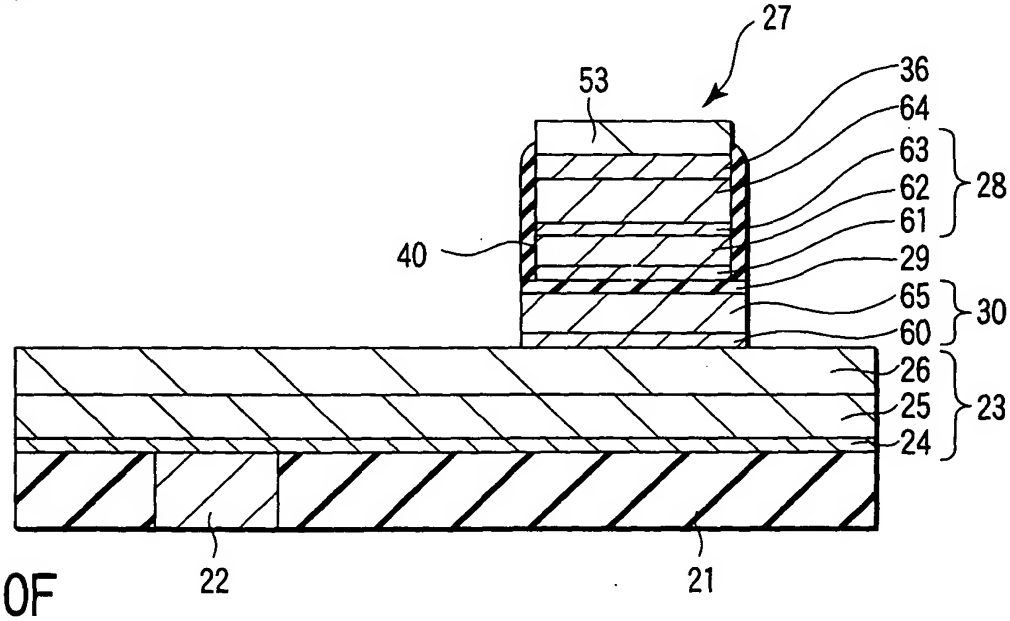


FIG. 20F

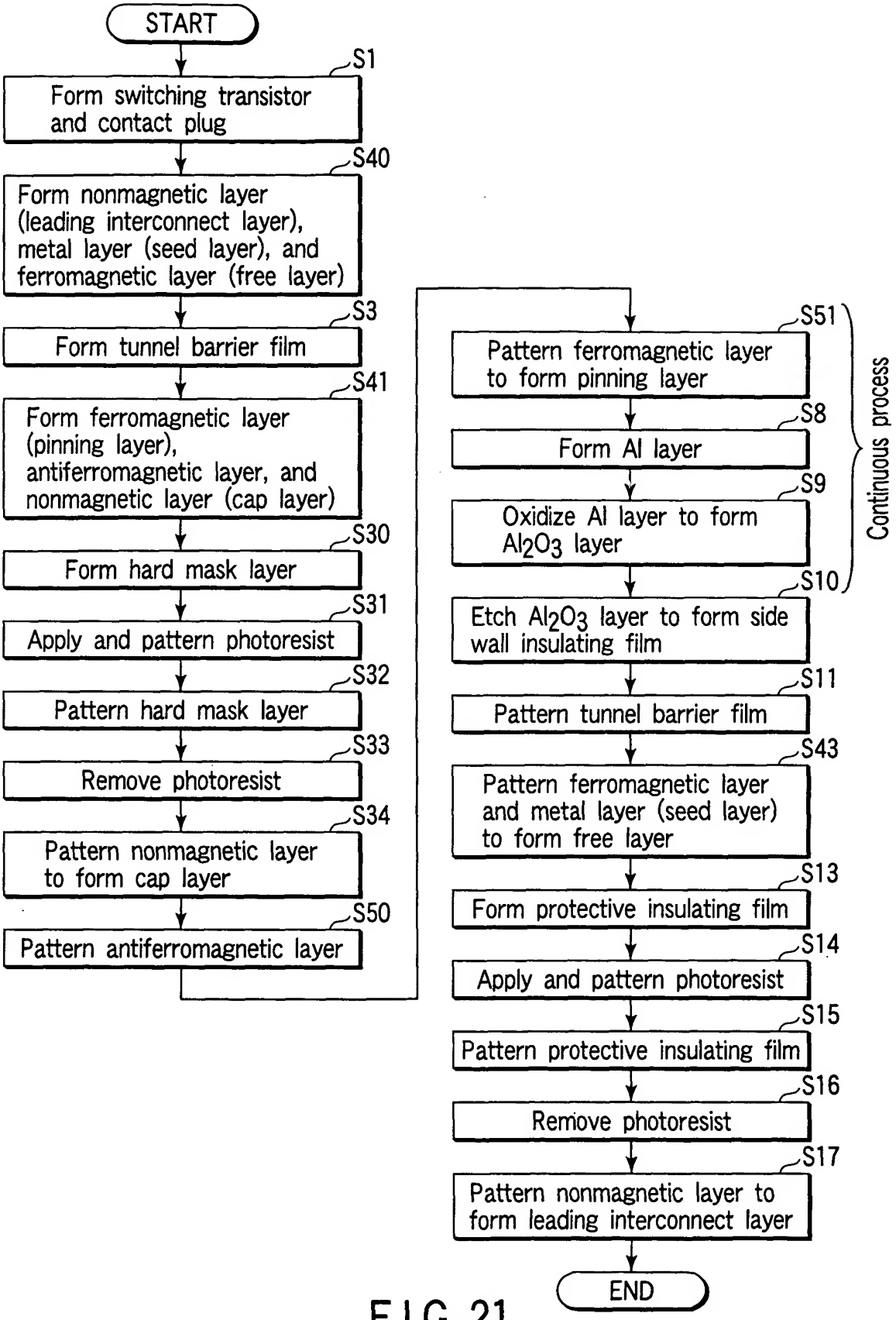

START
S1
Form switching transistor and contact plug
S40
Form nonmagnetic layer (leading interconnect layer), metal layer (seed layer), and ferromagnetic layer (free layer)
S3
Form tunnel barrier film
S41
Form ferromagnetic layer (pinning layer), antiferromagnetic layer, and nonmagnetic layer (cap layer)
S30
Form hard mask layer
S31
Apply and pattern photoresist
S32
Pattern hard mask layer
S33
Remove photoresist
S34
Pattern nonmagnetic layer to form cap layer
S50
Pattern antiferromagnetic layer
S51
Pattern ferromagnetic layer to form pinning layer
S8
Form Al layer
S9
Oxidize Al layer to form Al_2O_3 layer
S10
Etch Al_2O_3 layer to form side wall insulating film
S11
Pattern tunnel barrier film
S43
Pattern ferromagnetic layer and metal layer (seed layer) to form free layer
S13
Form protective insulating film
S14
Apply and pattern photoresist
S15
Pattern protective insulating film
S16
Remove photoresist
S17
Pattern nonmagnetic layer to form leading interconnect layer
END
Continuous process

FIG. 21

FIG. 22

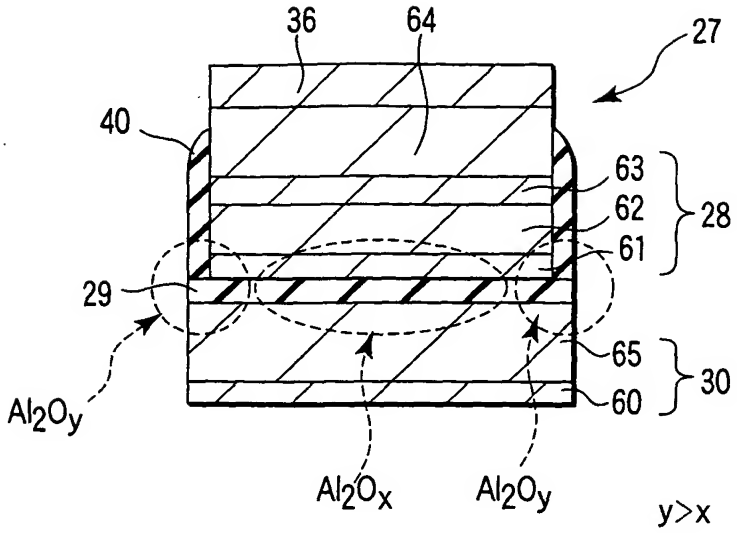


FIG. 23

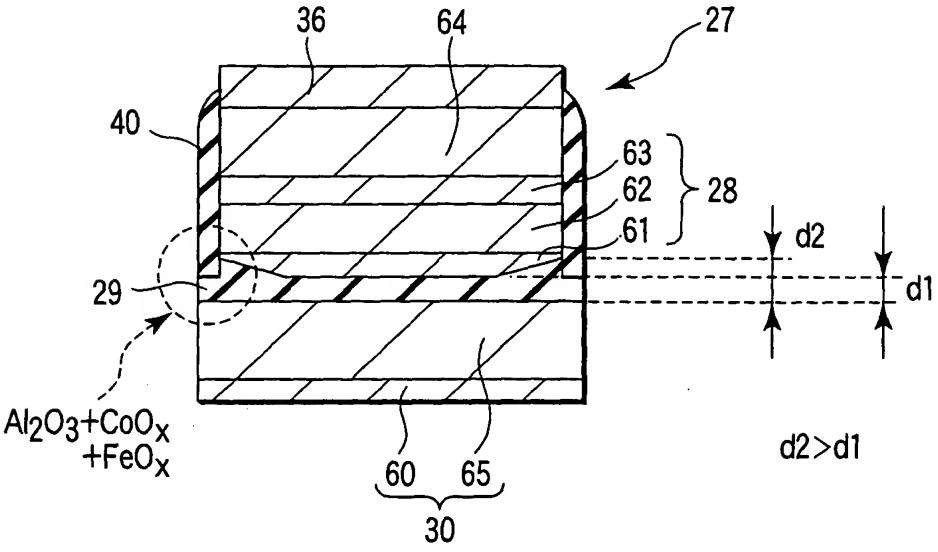
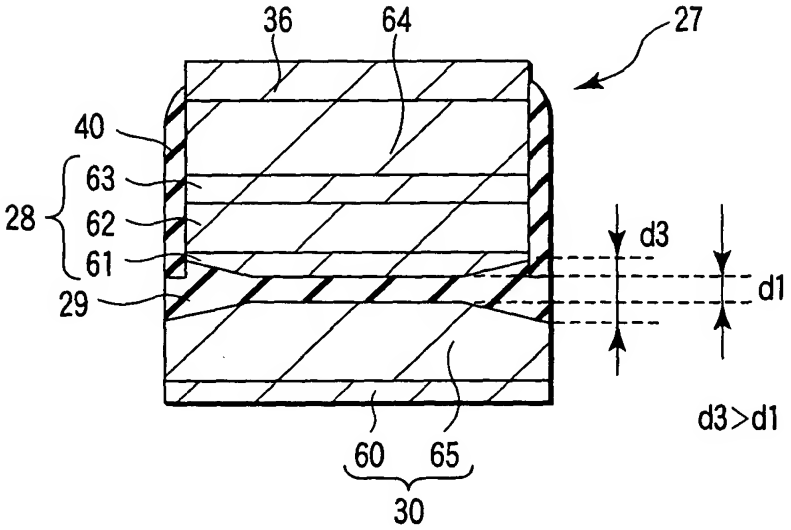


FIG. 24



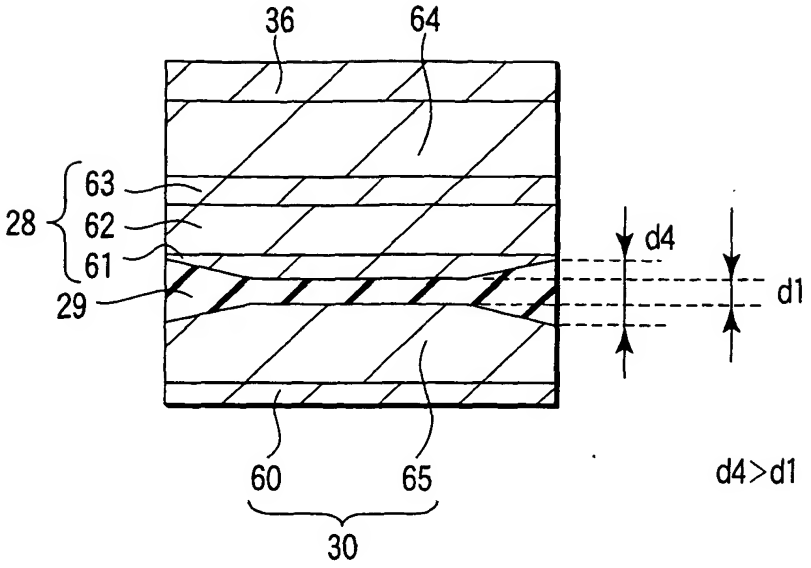


FIG. 25

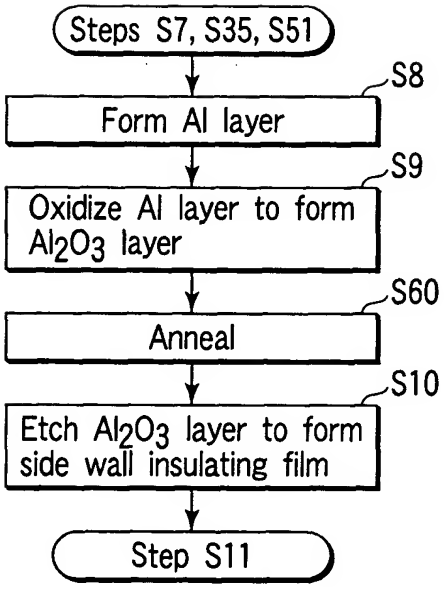


FIG. 26A

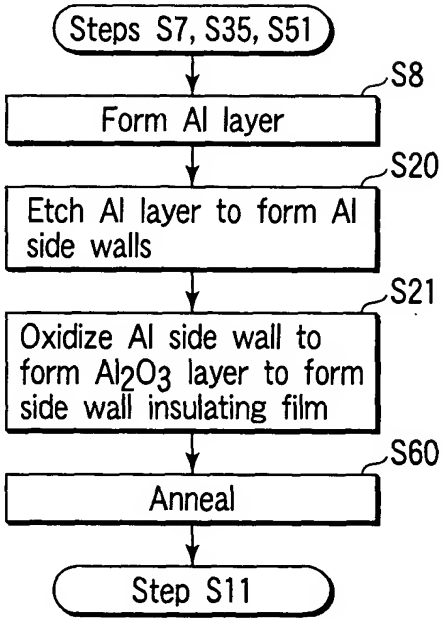


FIG. 26B

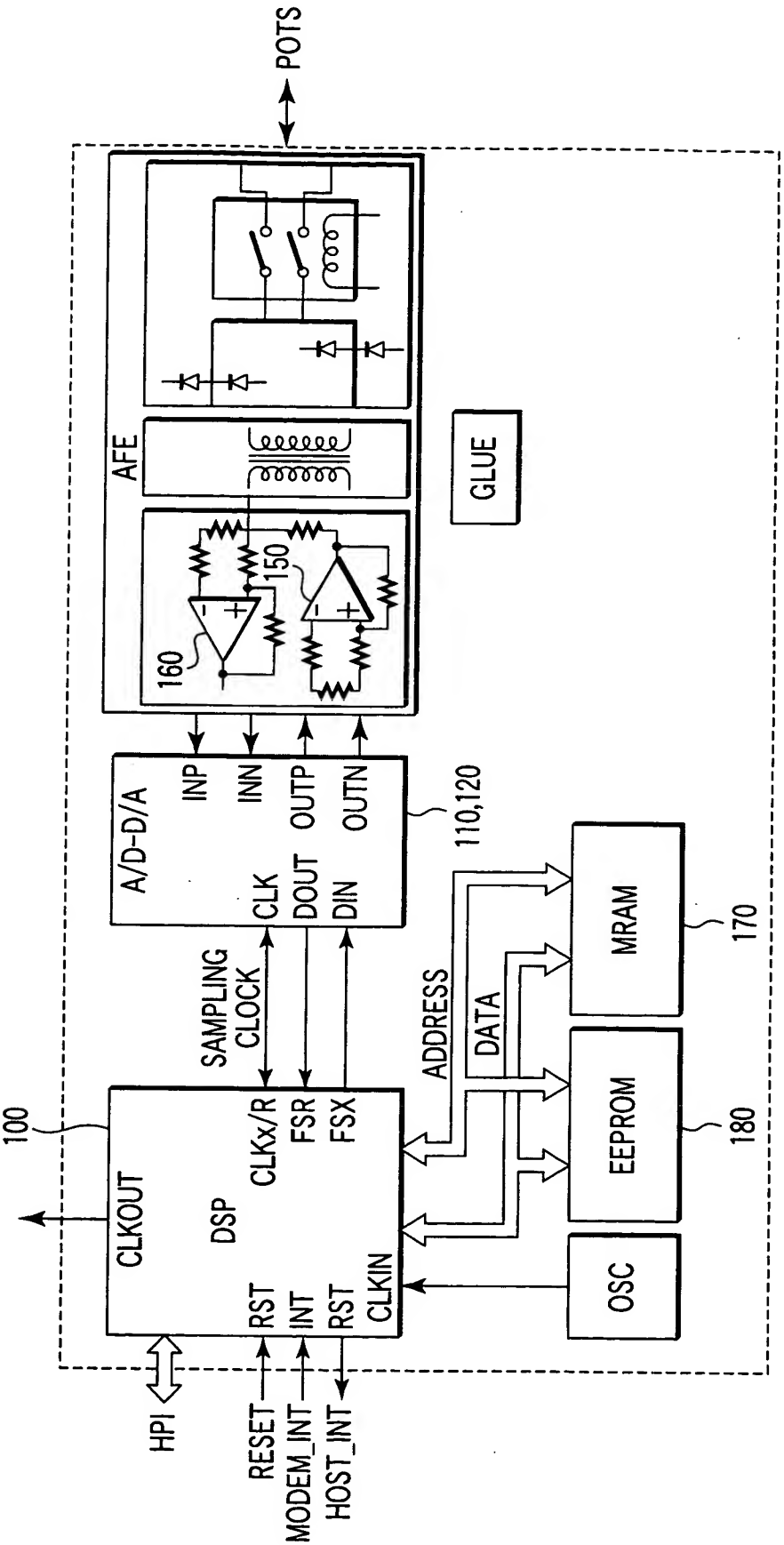

POTS
AFE
GLUE
150
160
A/D-D/A
INP
INN
OUTP
OUTN
CLK
DOUT
DIN
110,120
SAMPLING CLOCK
ADDRESS
DATA
MRAM
170
EEPROM
180
OSC
100
CLKOUT
DSP
CLKx/R
FSR
FSX
RST
INT
RST
CLKIN
HPI
RESET
MODEM_INT
HOST_INT

FIG. 27

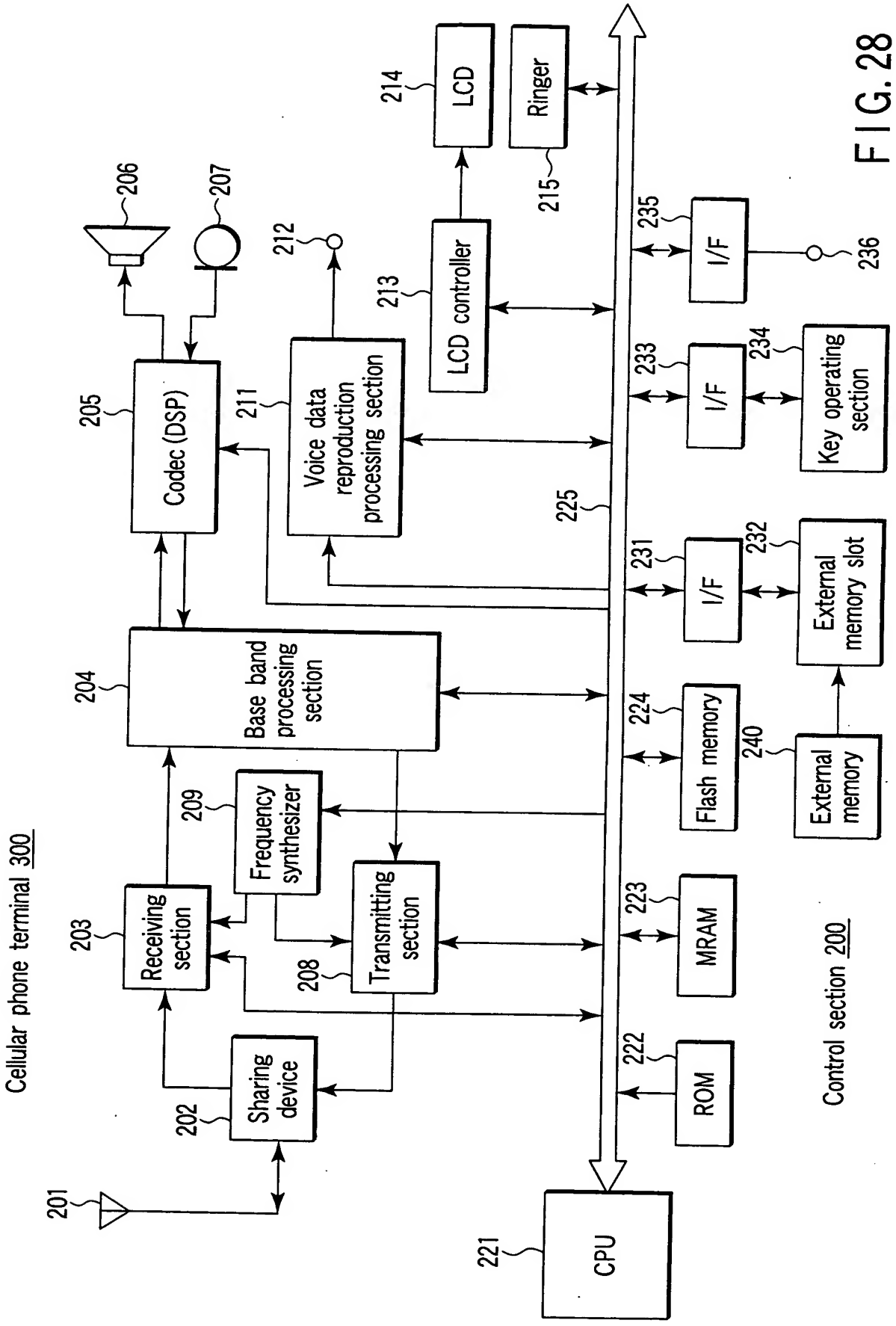

Cellular phone terminal 300
Control section 200
201
202
Sharing device
203
Receiving section
204
Base band processing section
205
Codec (DSP)
206
207
208
Transmitting section
209
Frequency synthesizer
211
Voice data reproduction processing section
212
213
LCD controller
214
LCD
215
Ringer
221
CPU
222
ROM
223
MRAM
224
Flash memory
225
231
I/F
232
External memory slot
233
I/F
234
Key operating section
235
I/F
236
240
External memory

FIG. 28

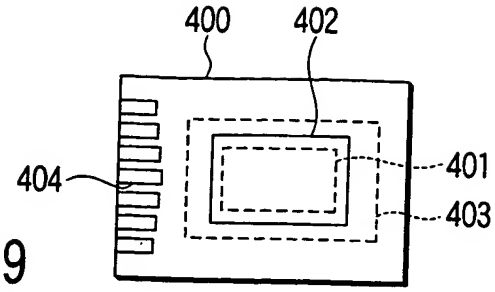


FIG. 29

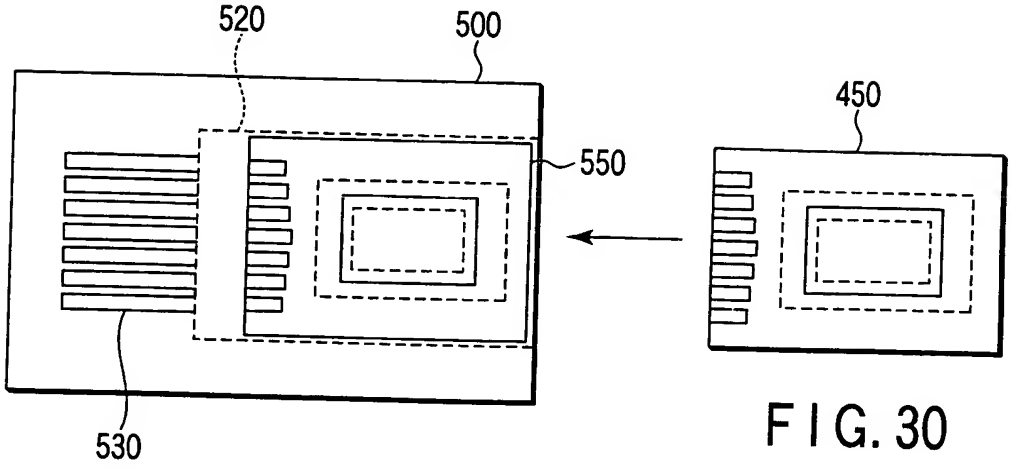


FIG. 30

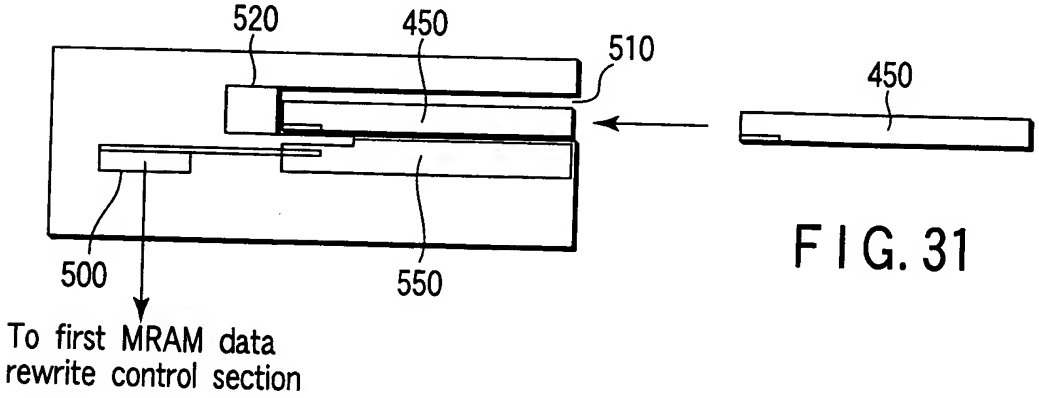


FIG. 31

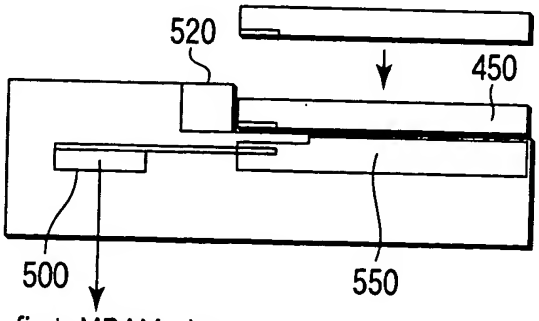


FIG. 32

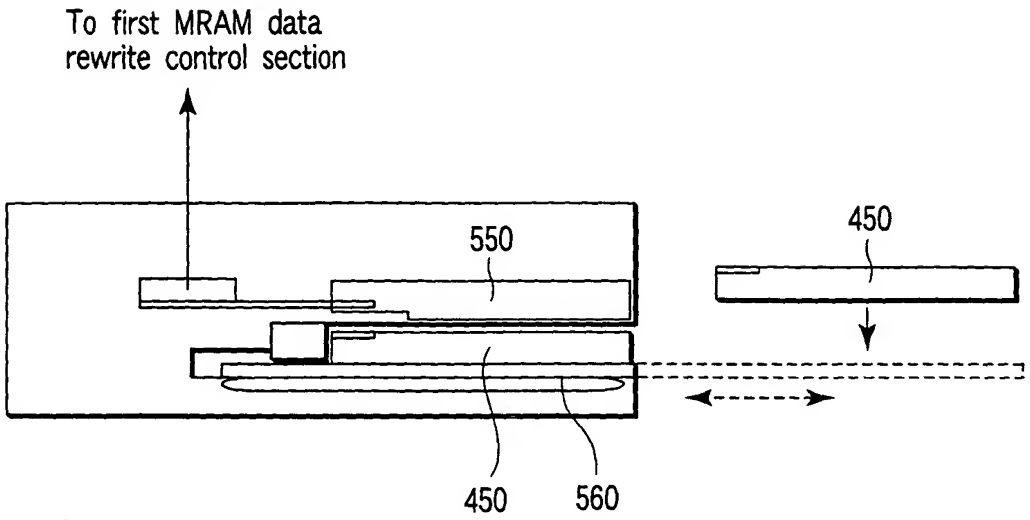


FIG. 33

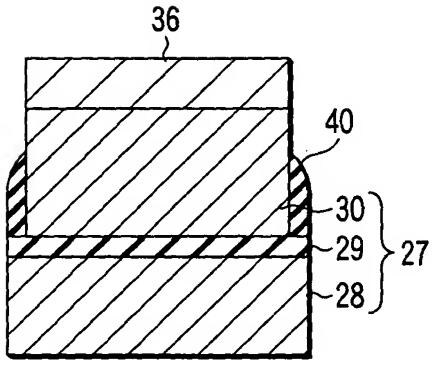


FIG. 34

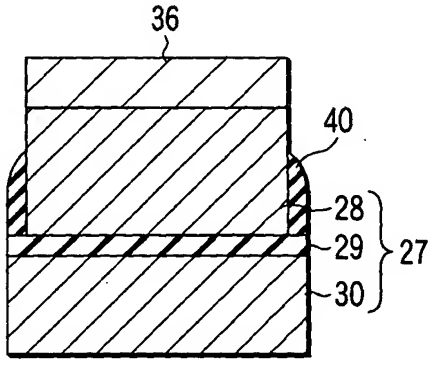


FIG. 35